FISHERY RESEARCH

STEELHEAD SUPPLEMENTATION IN IDAHO RIVERS
1995 Annual Report

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Prepared by:

Alan Byrne
Senior Fishery Research Biologist

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Steelhead Supplementation in Idaho Rivers

Project Progress Report

To evaluate the feasibility of using artificial production to increase natural steelhead populations and to collect baseline life history, genetic, and disease data from natural steelhead populations.

By

Alan Byrne
Senior Fishery Research Biologist

Idaho Department of Fish and Game
600 South Walnut Street
P.O. Box 25
Boise, ID 83707

Prepared for:

Tom Vogel, Project Manager
U.S. Department of Energy
Bonneville Power Administration
Division of Fish and Wildlife
P.O. Box 3621
Portland, OR 97283-3621

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ABSTRACT

The Steelhead Supplementation Study continued field experiments begun in 1993 that assess the ability of hatchery stocks to reestablish natural populations. We stocked hatchery adult steelhead *Oncorhynchus mykiss* trapped at Sawtooth Fish Hatchery for the third consecutive year in Beaver Creek. In the South Fork Red River, we stocked fingerlings that were reared at Clearwater Fish Hatchery from hatchery adults spawned at Dworshak National Fish Hatchery. We focused most of our effort in 1995 on monitoring and evaluating wild steelhead stocks. We operated a temporary weir to estimate the wild steelhead escapement in Fish Creek, a tributary of the Lochsa River. We intensively snorkeled six streams in the Clearwater River drainage and six streams in the Salmon River drainage. Juvenile steelhead densities declined in all streams compared with 1994. Crews operated screw traps and Passive Integrated Transponder (PIT) tagged 1,257 wild juvenile steelhead at six sites in the spring. We collected and PIT-tagged 1,506 wild juvenile steelhead in Fish and Gedney creeks during the summer. During the fall, crews operated six screw traps and one weir and PIT-tagged 1,171 wild juvenile steelhead. There were 1,296 wild steelhead smolts detected at Lower Granite, Little Goose, Lower Monumental, and other dams on the Columbia River downstream of the Snake River during the spring of 1995. Eighty-seven percent of the smolt detections were from fish tagged in Fish Creek (704), Crooked Fork Creek (154), Rapid River (148), and Gedney Creek (116).

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INTRODUCTION

The goal of supplementation is to increase natural fish production using artificial propagation without a negative effect on the productivity and abundance of existing natural populations. Supplementation was identified as a method to increase the anadromous fish runs in the Columbia River Basin (RASP 1992; NPPC 1987). Although a sustainable benefit from supplementation is unlikely without an improvement in passage conditions through the federal hydropower system in the Snake and Columbia rivers, supplementation may help rebuild Idaho steelhead *Oncorhynchus mykiss* populations in some rivers.

The goal of supplementation, an increase in natural production without negative impacts on the natural target and non-target populations, is a departure from previous fish hatchery management practices. The major supplementation question that needs to be resolved is whether it is possible to integrate artificial and natural production without an unacceptable risk to natural populations. Potential supplementation risks include: 1) reducing natural productivity below sustainable levels through genetic introgression with a less-fit supplementation stock; 2) displacement of naturally-produced fish through behavioral interactions with supplementation fish; 3) transmission of diseases; 4) excessive straying of returning hatchery adults; and 5) inadvertent selection or domestication of donor stocks brought into the hatchery. These risks should be addressed before the implementation of large-scale supplementation programs.

We are assessing the performance of two hatchery stocks in streams: the Sawtooth stock in tributaries of the Salmon River upstream of Sawtooth Fish Hatchery and the Dworshak stock in the Red River drainage, a tributary of the South Fork Clearwater River. Because of the lack of wild fish, we were unable to use a paired watershed approach to assess the hatchery stock(s) performance with a wild stock, as planned (Byrne 1994). Instead we are monitoring the performance of the hatchery fish in the study streams, by snorkel surveys and Passive Integrated Transponder (PIT) tagging, to determine if these hatchery stocks could be used to reestablish natural populations in tributaries of the upper Salmon and South Fork Clearwater rivers.

In addition to the field experiments with hatchery fish, we are monitoring and evaluating the status and gathering life-history attributes from wild steelhead stocks in the Clearwater and Salmon drainages.

OBJECTIVES

We continued working on the three objectives of this study implemented in 1993 (Byrne 1995 and 1997). Those three objectives are:

1. Assess the performance of hatchery and wild brood sources to reestablish steelhead in streams where extirpated.

2. Evaluate the ability of returning adults from hatchery smolt and fingerling releases to produce progeny in streams.

3. Assess the abundance, habitat, and life history characteristics of existing wild and natural steelhead populations in the Salmon and Clearwater river drainages.

STUDY AREA

The Steelhead Supplementation Study (SSS) is conducted in the Clearwater and Salmon river drainages of Idaho (Figures 1 and 2). Our research is coordinated with other Idaho Department of Fish and Game (IDFG) projects including: Idaho Chinook Supplementation (ISS), Bonneville Power Administration (BPA) project 89-093; Intensive Smolt Monitoring (ISM), BPA project 91-073; and General Parr Monitoring (GPM), BPA project 91-073.

In 1995, SSS crews snorkeled six streams in the Clearwater River drainage and six streams in the Salmon River drainage. I recorded stream temperatures at 37 sites in 31 streams. Idaho Department of Fish and Game personnel PIT-tagged wild juvenile steelhead at traps on Crooked Fork Creek, Fish Creek, Marsh Creek, Rapid River, Pahsimeroi River, and the South Fork Salmon River. I obtained juvenile steelhead PIT tag data from the Shoshone-Bannock Tribe's screw trap in the East Fork Salmon River. We continued our field experiments for Objectives 1 and 2 in Beaver Creek, Frenchman Creek, and the South Fork Red River.

METHODS

Objective 1

Collecting and Outplanting Adult Steelhead

Idaho Department of Fish and Game personnel stocked hatchery adult steelhead that returned to Sawtooth Fish Hatchery in Beaver Creek to evaluate the reproductive success and long-term fitness of the stock for supplementation, following the procedures outlined by Byrne (1994, 1996, and 1997). We began outplanting adult steelhead from Sawtooth Fish Hatchery in 1993. We did not stock Frenchman Creek this year because not enough adults returned to Sawtooth Fish Hatchery. Hatchery adults were randomly sorted from fish that returned to the Sawtooth Fish Hatchery between April 25 and May 9. We did not collect any wild adult steelhead to outplant in study streams because of the low escapement into Idaho in 1995.

We installed a temporary picket weir at the upstream and downstream boundaries of a stream section (about 1 km in length) before stocking the adults. The outplant site was the same area we used in 1993 and 1994. The adults were sexed and their fork length was measured to the nearest cm. The adults were trucked to Beaver Creek, placed in large Coleman coolers, transported to the study site with snowmobiles, and distributed throughout the 1 km study site. Idaho Department of Fish and Game personnel stocked a total of seven females and 10 males in Beaver Creek on April 28 and May 9. We made two stockings in Beaver Creek because there were not enough females entering the hatchery trap after April 25 to make one outplant. Personnel monitored the spawning, marked all redds, and removed the weirs after all the fish had spawned.

The fork length of female steelhead spawned at Sawtooth Fish Hatchery was measured to the nearest cm. Their eggs were incubated in individual egg trays and enumerated with an egg counter. I used regression analysis to develop a relation between fork length and fecundity. I used this relation to estimate the maximum egg deposition in Beaver Creek.

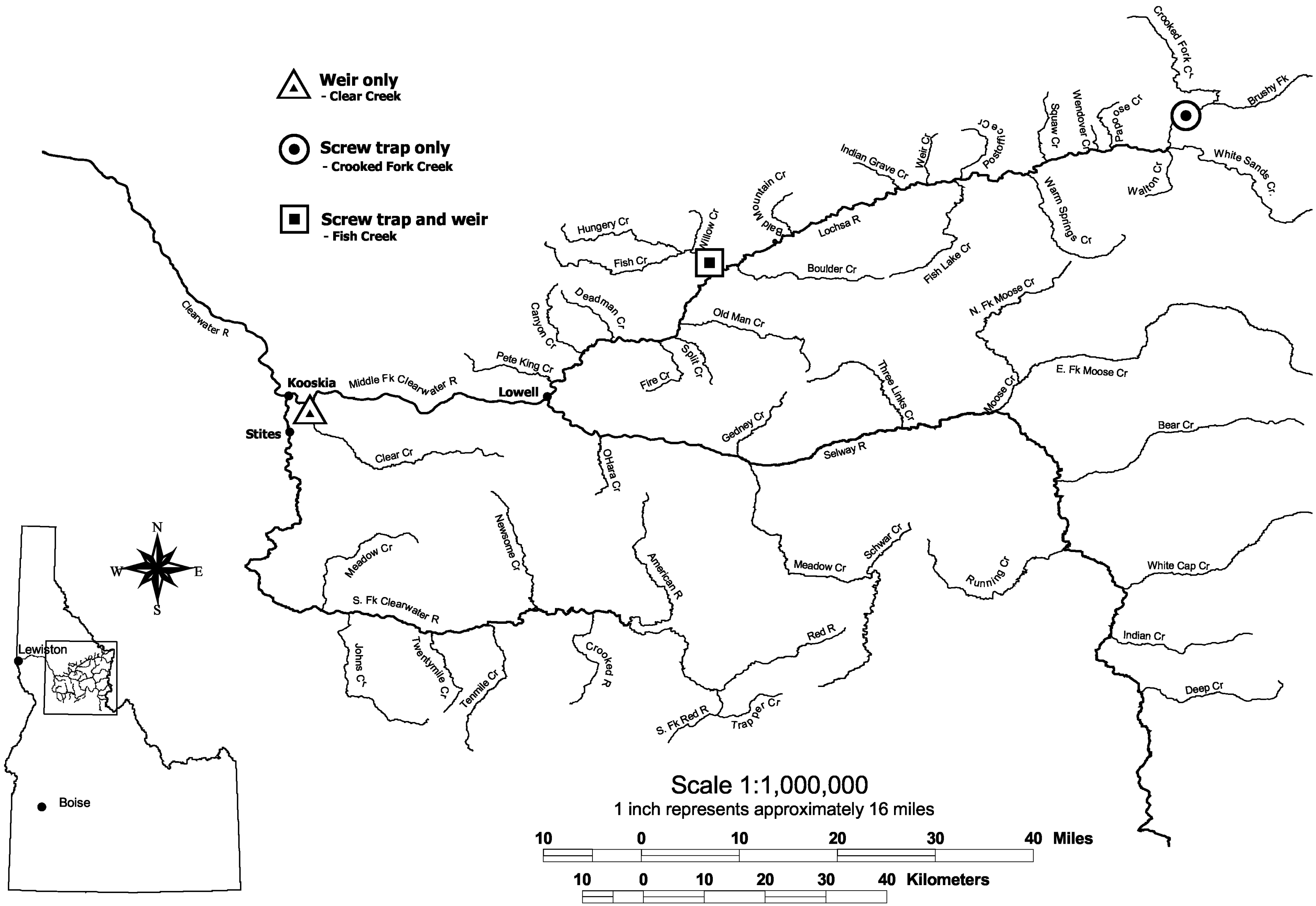


Figure 1. Location of the study streams in the Clearwater River drainage.

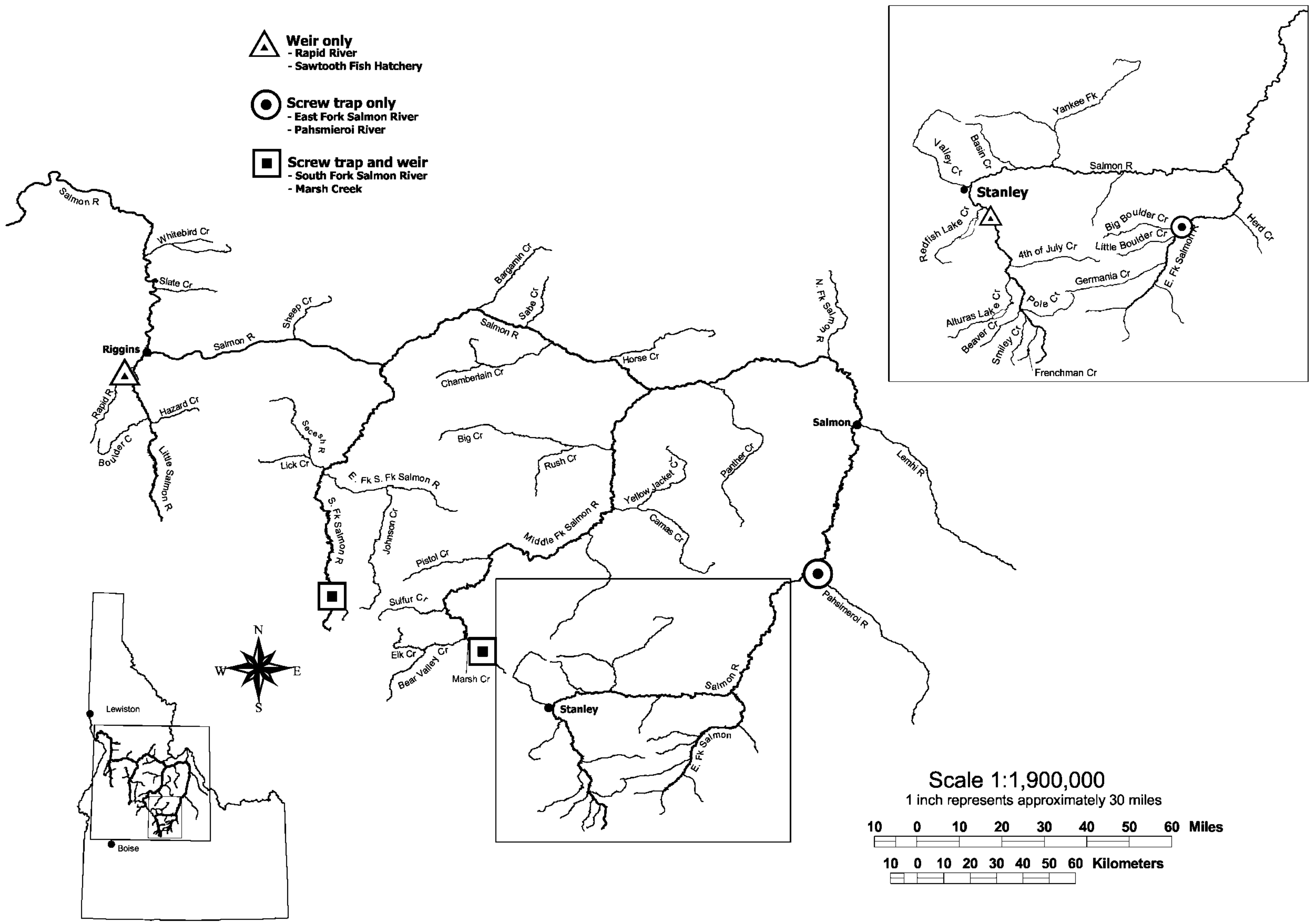


Figure 2. Location of the study streams in the Salmon River drainage.

Evaluation of Spawner Success

The stream temperature in Beaver Creek was recorded with Hobo™ temperature recorders (Onset Instruments, Pocasset, Massachusetts). I used the last day that a redd was built to predict the fry emergence date. I summed the daily mean temperature to calculate the number of temperature units (TU) in ºC in Beaver Creek. I assumed that fry emergence began when 556 TU were accumulated and was 95% complete after 722 TU were accumulated (Russ Thurow, U.S. Forest Service, Rocky Mountain Research Station, Boise, Idaho, unpublished data).

In 1994, IDFG personnel stocked Beaver and Frenchman creeks with hatchery adult steelhead. I used age-1 juvenile steelhead abundance (fish/100 m^2), based on snorkel surveys following the procedures outlined in the Objective 3, juvenile fish densities section, as an index of reproductive success. I assumed that all age-1 steelhead in Beaver and Frenchman creeks were the progeny of the 1994 hatchery adult outplants. In 1994, Sawtooth Fish Hatchery personnel released nine males (eight hatchery and one of natural origin) and nine females (five hatchery and four of natural origin) into the Salmon River directly upstream of the hatchery weir.

Objective 2

Fingerling Stocking

We released about 50,000 steelhead fingerlings, reared at Clearwater Fish Hatchery from Dworshak Hatchery stock, at three locations in the South Fork Red River on September 6, 1995 (Figure 3). I queried the Pacific States Marine Fisheries Commission's Columbia River Basin PIT Tag Information System (PTAGIS) database for previously released PIT-tagged fingerlings that were detected at the dams in 1995. I then determined the percentage of fingerlings detected to estimate the total number of smolts that migrated to the ocean from the fingerlings released in 1993 and 1994. An IDFG marking crew PIT-tagged about 5,000 fish and coded wire-tagged (CWT) 45,000 fish on August 21, 22, and 23, 1995. The adipose fin was not clipped on any fish, to prevent angler harvest on returning adults. All PIT-tagged fish were measured for fork length to the nearest 1 mm, and individual weights to the nearest 0.1 g were obtained from a random sample of 300 fish. The condition factor (K) of steelhead was calculated as:

$$K = \frac{W(100{,}000)}{L^3} \tag{1}$$

where W = weight in grams and
L = fork length in mm.

This was the third of four yearly fall fingerling releases (1993-1996) in the South Fork Red River.

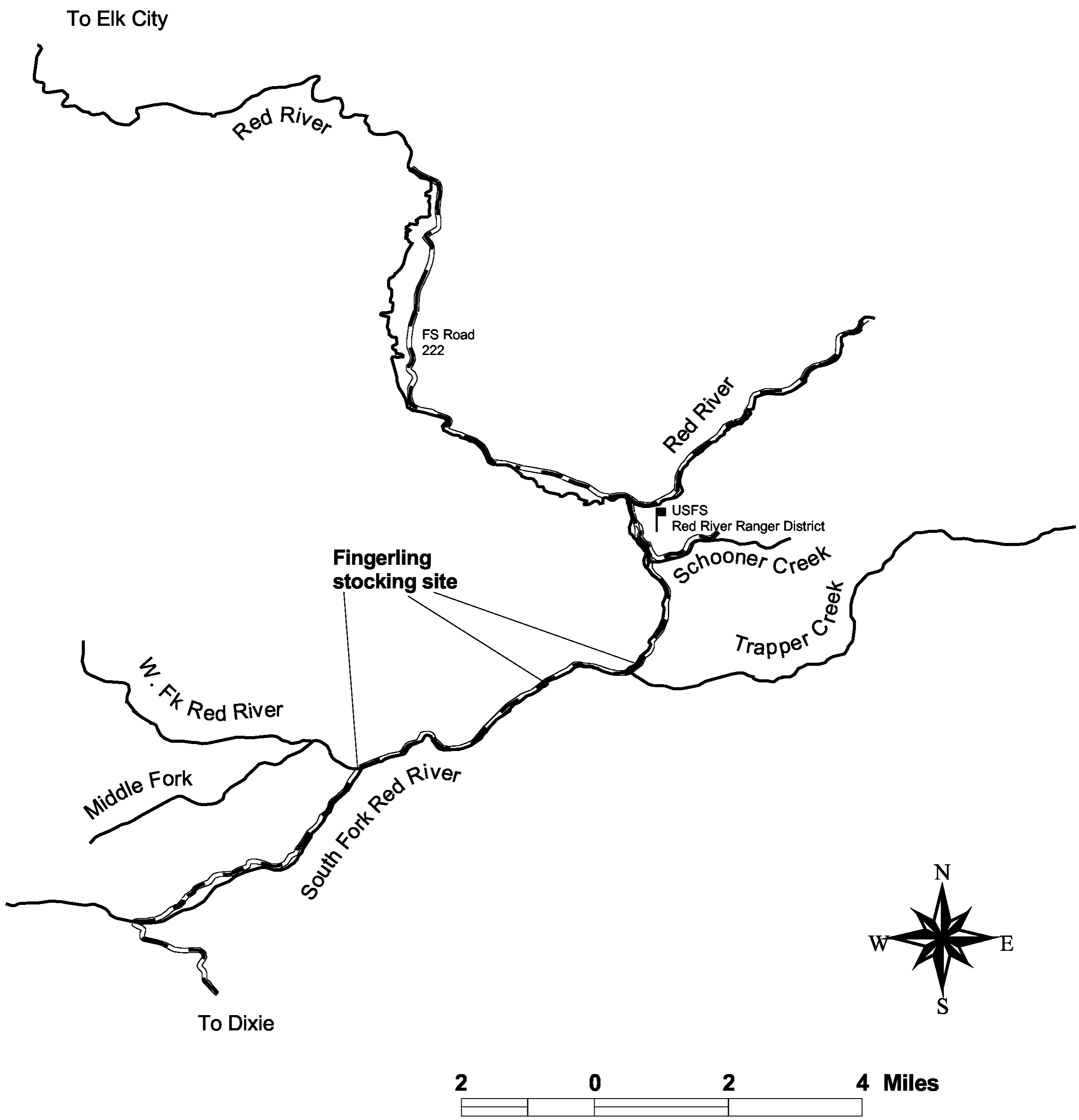


Figure 3. The location of the three sites where hatchery fingerlings were stocked on September 6, 1995 in the South Fork Red River.

Smolt Stocking

The IDFG will begin releasing about 4,000 hatchery smolts, reared at Clearwater Fish Hatchery from Dworshak Hatchery stock, in Red River upstream of the South Fork Red River beginning in spring 1996 and continuing yearly until 1999. The lag between fingerling and smolt stockings was planned so that most of the steelhead released as fingerlings migrate to the ocean as smolts during the years when hatchery smolts are released. Idaho Department of Fish and Game personnel will PIT tag all hatchery smolts before release.

<u>**Objective 3**</u>

Adult Steelhead Weir in Fish Creek

In 1995, IDFG personnel installed and operated a temporary weir in Fish Creek about 1 km upstream of its mouth. This weir had been installed and operated by the National Biological Service the prior three springs as part of a BPA-funded study of stock performance impacts of hatchery supplementation. The weir was installed March 6-10 and was closed on March 14. The holding box was checked several times throughout the day. When adult steelhead were present, we removed them with a net and placed them in a 100 gallon plastic water trough. We determined the sex, measured fork length to the nearest cm, collected scales, and used a paper punch to mark the right opercule prior to release upstream of the weir. We did not anesthetize the fish. The weir was removed June 12-14 after the spring runoff subsided. The river level was recorded each morning at the U.S. Forest Service (USFS) gauging station located near the mouth of Fish Creek.

Habitat Survey

Idaho Department of Fish and Game personnel walked Fish Creek in September 1995 and classified the predominant stream habitat every 10 m into pool, run, riffle, and pocket water (Shepard 1983). Although we surveyed Fish Creek in 1994, we repeated it this year because the flow in 1994 was extremely low from the drought. We did not repeat the survey in other streams that were surveyed in 1994 or 1993. Based on the survey, I divided streams into sections that reflected gradient, habitat, or stream order differences.

Juvenile Fish Densities

Steelhead supplementation crews snorkeled six streams in the Salmon River drainage and six in the Clearwater River drainage to estimate juvenile steelhead abundance. Each snorkel site consisted of a distinct habitat type and was chosen randomly throughout the stream section we surveyed. The number of snorkel sites for each habitat type was allocated proportional to the type's abundance in the stream section. Depending on stream size, one to five snorkelers counted fish in each site. Each snorkel site was separated by at least one distinct habitat type change from a prior site. Snorkelers estimated the size of all fish except chinook salmon *O. tshawytscha* parr, dace *Rhinichthys sp.,* and sculpin *Cottus sp.* to the nearest inch. After the site was snorkeled, we measured the length and three to six widths of the site to calculate surface area.

Chinook salmon parr and steelhead parr were aged based on observed size. Chinook salmon parr were counted and classified as age-0 (brood year 1994, <100 mm) or age-1 (brood year 1993, >100 mm). Steelhead parr were classified as: age-1, length 3 in to 5 in (76 mm to 127 mm); and age-2+, length >5 in (127 mm). Because steelhead fry (age-0, ≤75 mm) are indistinguishable from cutthroat trout *O. clarki* fry, we classified both as trout fry. We did not partition cutthroat trout, bull trout *Salvelinus confluentus*, brook trout *S. fontinalis*, or mountain whitefish *Prosopium williamsoni* into age classes.

Mean densities (fish/100 m^2) by habitat type in each stream section were calculated for trout fry, the two age classes of steelhead and chinook salmon, resident trout, and mountain whitefish. I calculated a weighted mean density (w_t) for each class of fish in stream sections that were habitat surveyed as:

$$W_t = \sum p_{it} d_{it} \tag{2}$$

where p_{it} = proportion of habitat *i* in stream section *t*,
d_{it} = mean density of fish in habitat *i* in stream section *t*,
i = pool, riffle, run, pocket water, and
t = stream section.

The weighted mean density of each class of fish for the entire stream (w_s) was found by:

$$\overline{W}_s = \sum \overline{w}_t A_t \tag{3}$$

where A_t = proportion of the stream surface area in section *t*.

Population Totals

The total age-1 and age-2+ steelhead population and confidence intervals were estimated for each stream section that had a habitat survey completed using the stratified sampling estimates of Scheaffer et al. (1986):

$$N_s = \sum_{i=1}^{4} A_i \overline{d}_i \tag{4}$$

where N_s = population total for section *s*,
A_i = total surface area, in section *s*, of habitat type *i*,
$\overline{d}_i$ = mean steelhead density, in section *s*, of habitat *i*, and
i = pool, riffle, run, pocket water.

The total surface area (A_i) of each habitat type in the stream section was calculated as:

$$A_i = L_s p_i w_i \tag{5}$$

where L_s = length of stream section *s*,
p_i = proportion of habitat *i* in stream section *s*, and
w_i = mean width of habitat *i* in section *s*.

An approximate 95% confidence interval (CI_s) on the population estimates in the stream section was calculated as:

$$CI_s = 2\sqrt{\sum_{i=1}^{h} A_i^2 \left(\frac{A_i - a_i}{A_i}\right)\left(\frac{s_i^2}{n_i}\right)} \quad (6)$$

where A_i = total surface area of habitat *i*,
s^2_i = the sample variance of mean steelhead density in habitat *i*,
a_i = total surface area of habitat *i* snorkeled in the section,
n_i = number of habitat *i* sites snorkeled in the section, and
i = pool, run, pocket water, or riffle habitat.

We treated A_i and a_i as constants when calculating CI and assumed that the variance was due to differences of densities in each snorkel site, not area measurements. The estimated total abundance of each age class for the entire stream was found by summing the estimates of all sections.

Stream Temperature

HOBO™ temperature recorders were located at 37 sites in 31 streams (Table 1). I began recording stream temperature at a new site in Herd Creek on October 25, 1995. The water temperature was recorded every 1.0 h to 1.6 h from early spring until late October. The recorders were reset to measure stream temperature every 1.0 h to 3.2 h, depending on location and access, throughout the winter. The daily mean, maximum, and minimum temperatures were calculated for each stream. I computed the number of TU (ºC) accrued in each stream from May 1 to October 15 by summing the daily mean temperature. The elevation of each recorder was determined from 7.5 min U.S. Geological Survey topographic maps. I used regression analysis to determine the relation between elevation and TU accrued between May 1 and October 15 for all data combined and by the Clearwater and Salmon river drainages. I compared the number of TU accrued between May 1 and October 15, 1995 with the same period in 1994 to determine the percent of change in water temperature between years in streams where the data was available.

PIT Tagging

Personnel operating screw traps on Crooked Fork Creek, Fish Creek, East Fork Salmon River, Marsh Creek, Pahsimeroi River, and South Fork Salmon River PIT-tagged wild steelhead captured during the spring (March 7 to June 14). During the fall (August 15 to December 5), we operated screw traps and tagged steelhead at all the spring sites. We tagged steelhead that were captured by a weir designed to trap bull trout in Rapid River from July 26 to November 3. We tagged steelhead >70 mm and measured fork length to the nearest mm and weight to the nearest 0.1 g. The traps were checked daily and the number of steelhead captured was recorded. Each fish was scanned before tagging to verify that it had not been tagged previously. We followed PIT-tagging procedures outlined for chinook salmon in Kiefer and Forster (1991) and PIT Tag Steering Committee (1993). No more than 20 juveniles were anesthetized with MS-222 at one time.

Table 1. Location of temperature recorders and the date temperature recording began.

Stream	Date	Location
Salmon River drainage		
Basin Creek	9/22/94	200 m upstream of hot spring
Beaver Creek	6/07/93	3 km upstream of mouth
Big Boulder Creek	9/22/94	200 m upstream of mouth
Capehorn Creek	9/22/94	30 m upstream of Highway 21 bridge
East Fork Salmon River 1	1/29/94	100 m upstream of mouth
East Fork Salmon River 2	1/29/94	At hatchery weir
East Fork Salmon River 3	10/19/94	100 downstream of Fisher Creek
East Fork Salmon River 4	6/08/93	Upstream of Bowery hot springs
Frenchman Creek	6/07/93	3 km upstream of mouth
Fourth of July Creek	6/21/94	50 m upstream of USFS boundary
Germania Creek	6/08/93	20 m upstream of irrigation diversion
Herd Creek	10/25/95	1 km upstream of mouth
Marsh Creek	6/07/93	20 m downstream of adult weir site
Pole Creek	6/21/94	2 km upstream of irrigation diversion
Redfish Lake Creek	5/05/94	at weir site
Salmon River 1	1/29/94	200 m upstream of EF Salmon River
Salmon River 2	3/29/94	at Sawtooth Hatchery
South Fork Salmon River	3/08/94	at hatchery weir site
Smiley Creek	6/07/93	4 km upstream of mouth
Valley Creek	6/08/93	70 m upstream of Meadow Creek
West Pass Creek	6/08/93	20 m upstream of irrigation diversion
Clearwater River drainage		
Bald Mountain Creek	10/02/94	20 m downstream of Highway 12 bridge
Canyon Creek	6/10/93	300 m upstream of mouth
Crooked Fork Creek	6/09/93	70 m upstream of Brushy Fork Creek
Fish Creek 1	6/09/93	1 km upstream of mouth
Fish Creek 2	7/12/94	50 m upstream of Pagoda Creek
Fish Creek (air)	6/08/95	at trailhead
Fish Creek (humidity)	6/08/95	at trailhead
Fish Creek (barometric pressure)	6/08/95	at trailhead
Gedney Creek	9/09/94	200 m upstream of mouth
Lost Creek	10/02/94	20 m downstream of Highway 12 bridge
Post Office Creek	6/09/93	100 m upstream of mouth
Red River	6/10/93	1 km upstream of SF Red River
South Fork Red River 1	6/10/93	50 m upstream of Schooner Creek
South Fork Red River 2	10/27/94	1.5 km upstream of Trapper Creek
Trapper Creek	6/29/94	100 m upstream of mouth
Walton Creek	6/09/93	50 m upstream of hatchery intake
Weir Creek	6/09/93	300 m upstream of mouth
Wendover Creek	7/13/94	200 m upstream of Highway 12 bridge
West Fork Gedney Creek	7/24/94	20 m upstream of mouth

The PIT-tagging equipment was sterilized with a 70% ethanol solution to reduce disease transfer between fish. Tagged juveniles were held 1 h to 24 h to observe mortality and tag rejection, then released.

Steelhead supplementation crews PIT-tagged juvenile steelhead in Gedney and Fish creeks in July, August, and September. We captured the fish by fly-fishing with size 16 barbless flies. Steelhead were released throughout the area where they were captured after a 1 h to 4 h recovery period.

Fish were grouped into 5 mm length classes (class 70 = fish 70-74 mm, class 75 = fish 75-79 mm, etc.) and the length frequency of the PIT-tagged fish was plotted. Condition factor (Equation 1) was calculated for all fish that were weighed and measured. The cumulative distribution of the number of fish caught was plotted for the spring and fall trapping periods. Analysis of variance (ANOVA) for unbalanced designs was used to test for differences in fish length and fish condition factor among streams. When significant differences were detected, the Tukey-Kramer HSD multiple comparison test was used for all pairwise comparisons among the streams (SYSTAT, Inc. 1992).

Growth

We recaptured enough previously PIT-tagged juvenile steelhead parr in Fish and Gedney creeks to calculate a mean growth rate for each stream. I calculated the growth rate (G) of a fish as:

$$G = \frac{L_2 - L_1}{D} \tag{7}$$

where L_1 = length at first capture,
L_2 = length at second capture and,
D = number of days between the two captures.

I calculated the Pearson correlation coefficient between growth rate and length at first capture for all data combined and for each stream. I also calculated the Pearson correlation coefficient between growth rate and the number of days between capture for all data combined and in Fish Creek.

Smolt Detections and Travel Time to Lower Granite Dam

I obtained the number, date of tagging, length, and weight at tagging of smolts that were detected at Lower Granite, Little Goose, Lower Monumental, and McNary dams in 1995 for each release site from the PTAGIS database. The detected smolts that were tagged in fall 1994 (tagged August 15 to December 5, 1994) or spring 1995 (tagged March 15 to June 15, 1995) were tested (t-test) for differences in length and condition factor.

Smolt travel time from release site to Lower Granite Dam (LGR) was calculated for all sites where fish were tagged during spring 1995. The detected fish, arrival dates at LGR, and travel times (in days) to LGR were downloaded from the PTAGIS database. Travel time was converted to km traveled per day from the release site to LGR. The median arrival date and the cumulative distribution function of arrival date at LGR was calculated for each release site and for fish that were tagged in fall 1994 and spring 1995. I used the Smirnov test (Conover 1980) to test whether the cumulative distribution of arrival time at LGR differed between smolts that were tagged in fall 1994 and spring 1995. For each stream, I calculated the median travel time to LGR and the CI with confidence 90%. The confidence interval for streams with <25 detections at LGR were determined using the binomial distribution. If there were 25 detections at LGR, I used the normal approximation to a binomial distribution (Zar 1984, Steinhorst et al. 1988) to calculate CI. I calculated the Pearson correlation coefficient between travel time and tagging date and length for the spring tagged smolts detected at LGR.

Adult and Juvenile Steelhead Scale Samples

Scales, fork length, and sex were obtained from naturally-produced adult steelhead trapped in Clear Creek at Kooskia National Fish Hatchery and Fish Creek during the spring. We collected scales and fork lengths of age-1+ juveniles from Fish Creek and the South Fork Salmon River. Scales were taken from both sides of the fish from the preferred area (MacLellan 1987). This area is located just above the lateral line, posterior of a vertical line drawn from the posterior end of the dorsal fin. All scales were mounted in acetate for future aging.

RESULTS

Objective 1

Collecting and Outplanting Adult Steelhead

We stocked Beaver Creek with five males and five females on April 28, and five males and two females on May 9. The average length of the males and females were 62 cm and 60 cm, respectively (Table 2). We made our last redd count on May 9; thereafter the water was too high and turbid to make an accurate redd count. A total of five redds were counted.

Table 2. The number, date, and mean length of hatchery steelhead that were outplanted in Beaver Creek during the spring of 1995. The standard deviation of the mean is in parentheses.

		Number of		Mean Length of		Number of
	Date	Males	Females	Males	Females	Redds
Beaver Creek	4/28	5	5	63 (8)	59 (3)	--
Beaver Creek	5/9	5	2	61 (3)	63 (10)	--
Beaver Creek	Total	10	7	62 (5)	60 (5)	5 [a]
Sawtooth Fish Hatchery	4/6-5/10	--	119	--	63 (6)	--

[a] The last redd count was on May 9. We were unable to count redds after May 9 because of high turbid flows.

The regression of fecundity on fork length (Figure 4) of hatchery females spawned at Sawtooth Fish Hatchery from April 6 to May 10 was significant ($r^2 = 0.29$, df = 117, $p < 0.001$). I used this relation to determine that the maximum egg deposition in Beaver Creek, assuming that all seven females spawned, was 27,342 (90% CI = $\pm$ 17,871).

Evaluation of Spawner Success

I used May 10 as the starting date to predict the date of fry emergence. This year the predicted emergence date was August 7 with 95% fry emergence by August 25 (Figure 5). An IDFG crew snorkeled Beaver Creek on August 3 and only counted 14 fry in the adult outplant section of the stream. The fry density was <1 fry/100 m^2, compared to nearly 23 fry/100 m^2 in 1994 (Figure 6a); however, we snorkeled Beaver Creek prior to the predicted fry emergence date this year. The age-1 density in the outplant section was 4.13 fish/100 m^2 this year, a decline from 10.71 fish/100 m^2 observed in 1994 (Figure 6b). I estimated the age-1 steelhead population in Beaver Creek, downstream of the adult outplant area, was 720 (±389). I estimated that the maximum egg deposition in the spring of 1994 was 38,888. The egg-to-age-1 survival was 1.85%, assuming there was no movement of fish out of Beaver Creek.

An IDFG crew snorkeled Frenchman Creek on August 4. In the outplant section the fry density was 0.94 fry/100 m^2, and the age-1 density was 2.93 fish/100 m^2. The presence of fry was unexpected, as we did not stock Frenchman Creek with adult steelhead in 1995. The fry could be from natural spawning or were slow growing fish that emerged late in 1994. Both the fry and age-1 densities declined from those observed in 1994. I did not estimate the survival from egg-to-age-1 in Frenchman Creek, since I could not accurately estimate the 1994 egg deposition because of otter predation on adults (Byrne, 1997).

Objective 2

Fingerling Stocking

The average length and condition factor of the fingerlings at the time of tagging were 86 mm (95% CI <±1 mm, n = 5,000) and 1.09134 (95% CI ±0.10301, n = 400), respectively. The fish were stocked in the South Fork Red River on September 6, 1995. We did not monitor the movement of the fingerlings after they were stocked.

The juvenile steelhead densities from the mouth to the West Fork South Fork Red River were 2.67 age-1 fish/100 m^2 and 1.02 age-2+ fish/100 m^2. I estimated the age-1 population was 1,806 fish. If all age-1 fish were from the fall 1994 stocking and there was no movement out of the stream, then the survival rate of the fish stocked in the fall 1994 was 3.6%

In 1995, there were eight smolt detections (of 5,000 PIT tagged) that were released in the fall 1993, a detection rate of 0.16%. I estimate that 80 smolts migrated to the ocean from the 1993 stocking in the spring 1995. There were no smolt detections from the fingerling group stocked in the fall of 1994.

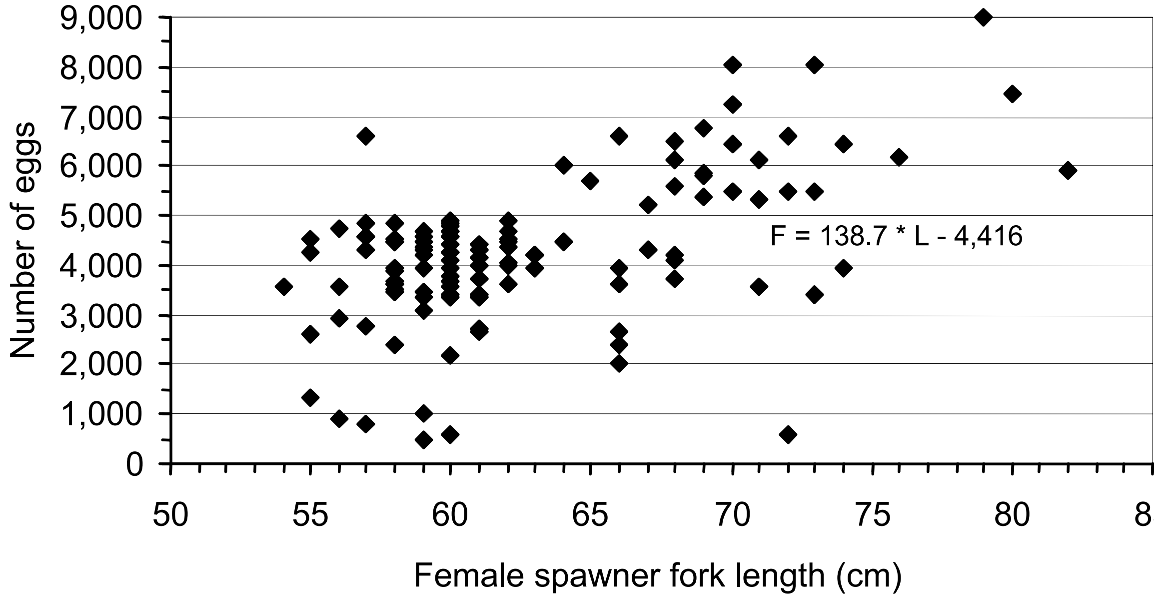


Figure 4. The relationship between female fork length (L) and fecundity (F) of hatchery steelhead spawned at Sawtooth Fish Hatchery in 1995. The regression was significant ($r^2 = 0.29$, $p<0.001$).

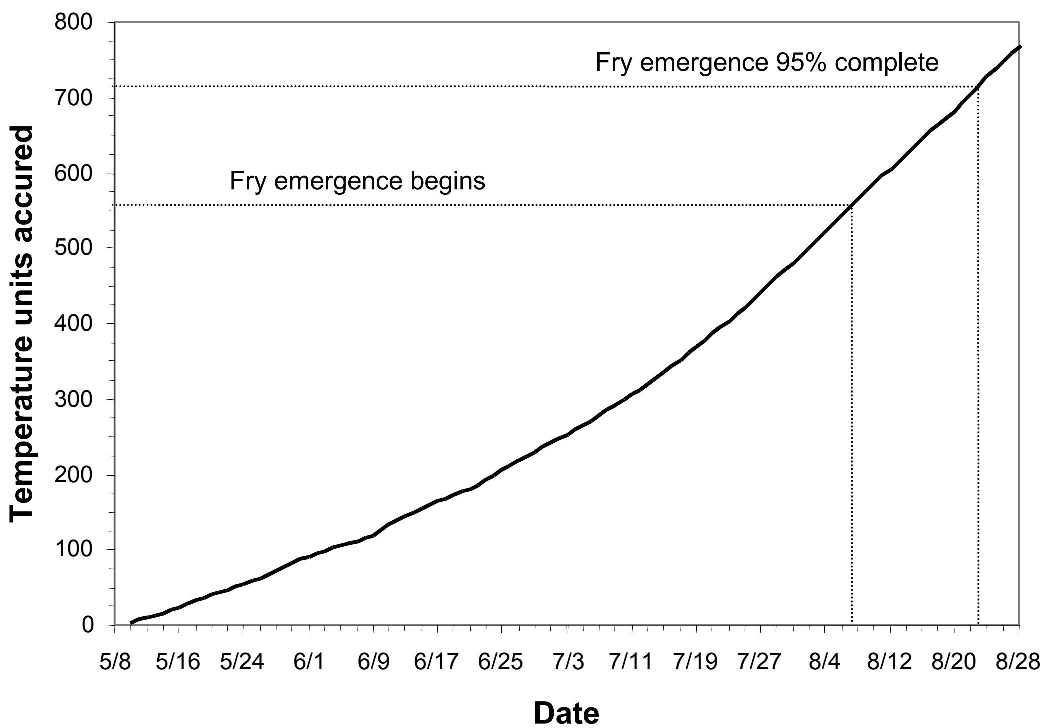


Figure 5. The amount of temperature units (ºC) accrued in Beaver Creek from the estimated steelhead spawning date, the predicted date of first emergence, and the date that emergence was 95% complete.

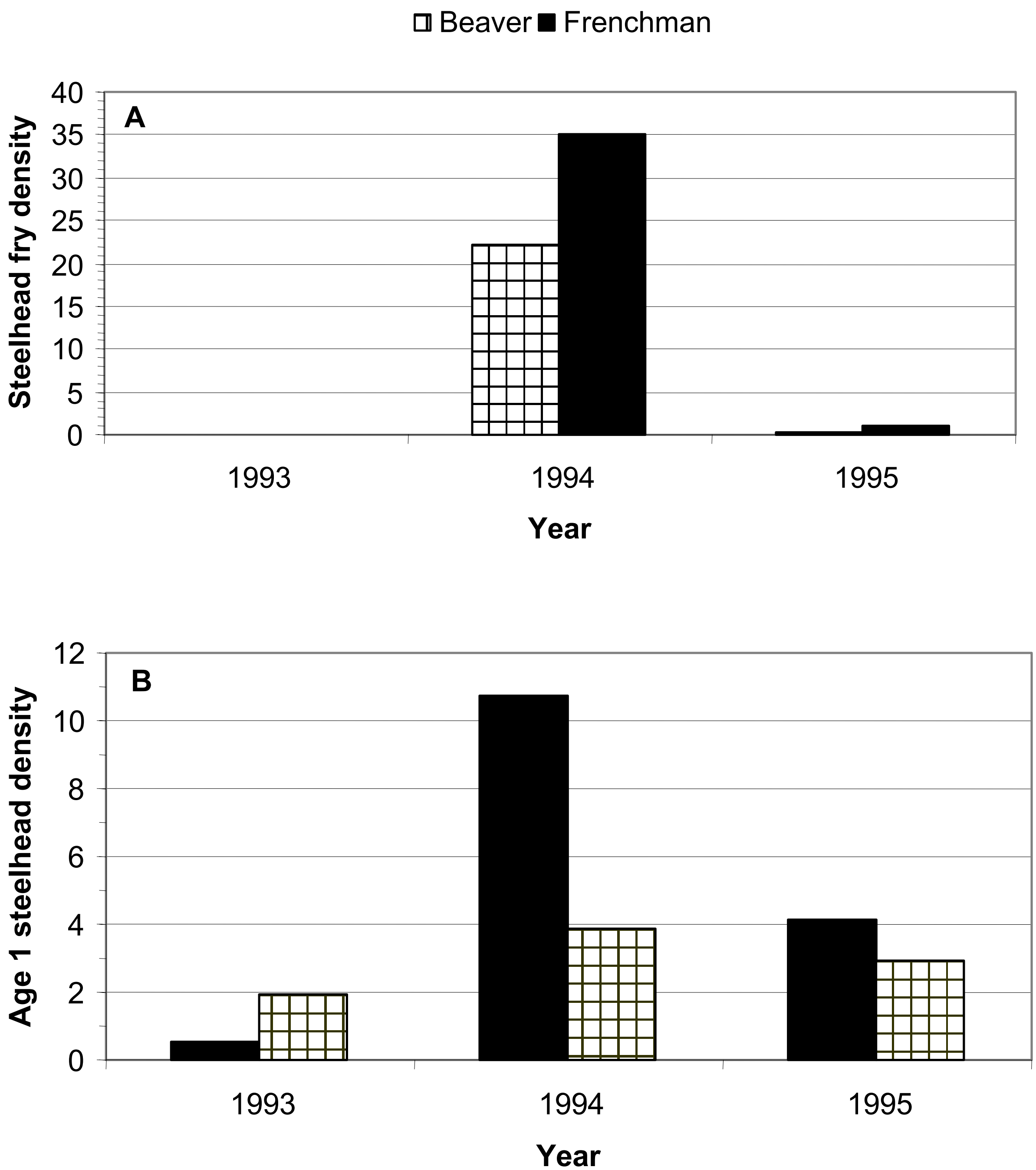


Figure 6. The fry and age-1 density (fish/100 m^2) of steelhead in Beaver and Frenchman creeks from 1993 to 1995. (A) Fry densities. (B) Age-1 densities.

Objective 3

Adult Steelhead Weir in Fish Creek

We operated the weir from March 14 to May 2 and passed 15 males and 17 females (Figure 7a). The first adult was trapped on March 21. We opened the weir to allow free passage of steelhead adults on May 2 because river otters were killing fish near the weir site. The escapement in 1995 was the lowest recorded since the weir was installed in 1992 (Figure 7b). The average length of the males was 84 cm (n = 15, 95% CI = $\pm$ 4 cm) and ranged from 65 cm to 91 cm. The average female length was 81 cm (n = 17, 95% CI = ±2 cm) and ranged from 76 cm to 90 cm (Figure 8).

Habitat Survey

We classified the habitat in Fish Creek from Hungery Creek to the mouth on September 13, 1995. The habitat in this section of Fish Creek was 4.9% pools, 23.5% runs, 59.7% pocket water, and 12% riffles. The habitat percentages do not add to 100% because of rounding error. The rank of the prevalence of each habitat type remained the same compared with the survey we did in 1994, but the percentage of the stream classified as pocket water increased this year and the percentage of all other habitat types declined (Table 3).

Juvenile Fish Densities

We snorkeled six streams in the Clearwater River basin and six streams in the Salmon River basin (Table 4). Steelhead age-1 and age-2+ densities in the Salmon River tributaries were <2 fish/100 m^2, except in the supplemented section of Beaver Creek (strata 2), the supplemented section of Frenchman Creek (strata 1), Basin Creek, and pool habitat in Marsh Creek (Table 5). We did not see any steelhead fry or parr in West Pass Creek.

The steelhead densities were higher in the Clearwater River drainage, as they have been since this study began snorkeling in 1993 (Table 6). We snorkeled Fish Creek twice because we were unable to snorkel the lower 3.5 km in July due to high flows. Steelhead age-1 and age-2+ densities were usually >5 fish/100 m^2 in pocket water habitat and >10 fish/100 m^2 in pool and run habitat in the Gedney and Fish creek drainages. The South Fork Red River, although it was stocked with 50,000 fingerlings in the fall of 1993 and 1994, had the lowest densities in the Clearwater River drainage.

The weighted (overall) mean density of all steelhead parr was highest in West Fork Gedney Creek (19.46 fish/100 m^2) and lowest in West Pass Creek (0 fish/100 m^2). The age-1 densities exceeded 10 fish/100 m^2 only in West Fork Gedney and Fish creeks. The highest age-2+ density was 8.75 fish/100 m^2 in West Fork Gedney Creek (Table 7).

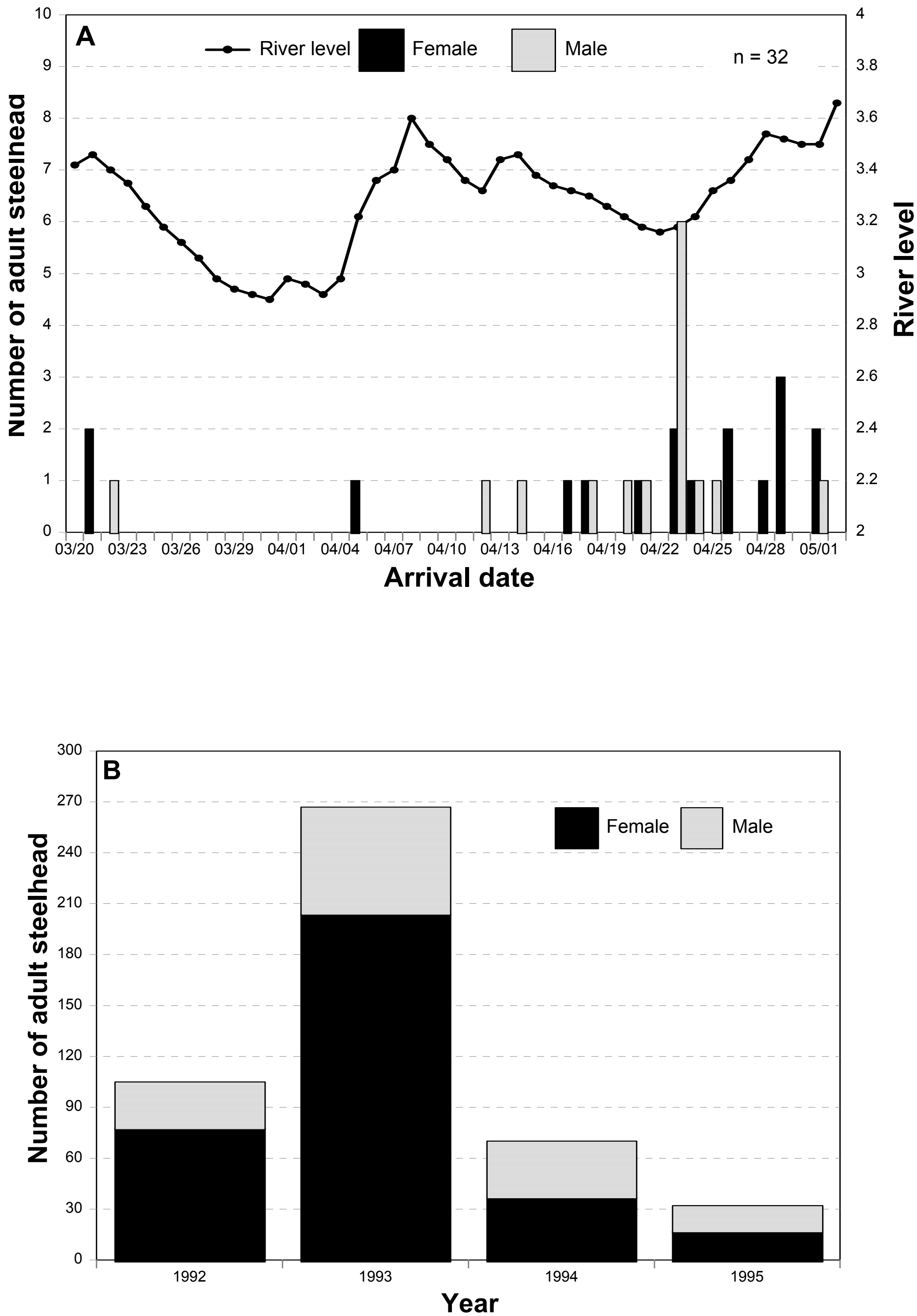


Figure 7. (A) The daily number of wild adult male and female steelhead that were trapped at the Fish Creek weir in 1995 and the daily river level at the USFS gauge. (B) The number of wild adult steelhead trapped at the Fish Creek weir from 1992 to 1995.

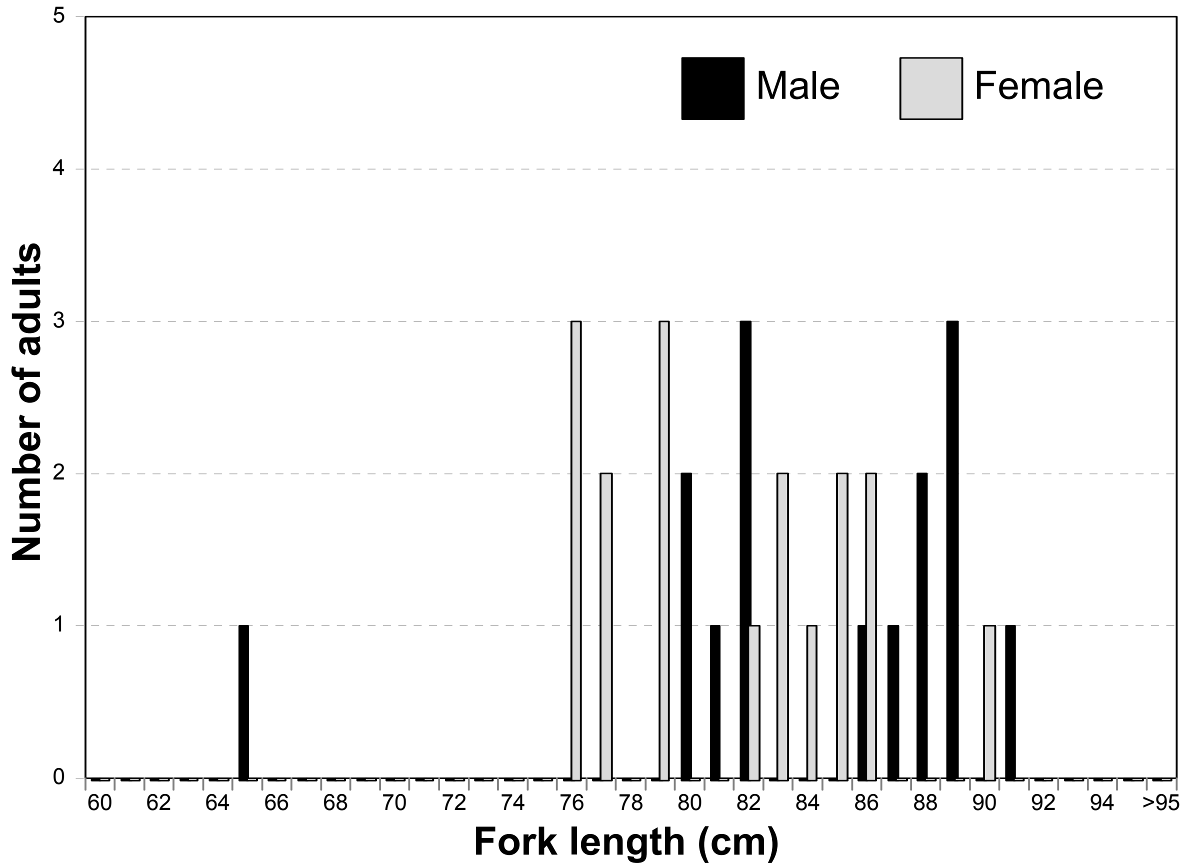


Figure 8. The length frequency of wild adult males and females trapped at the Fish Creek weir in 1995.

Table 3. The percentage of each habitat and stream length (km) from the 10-pace surveys. PW = pocket water.

Stream	Date	Section	Pool	Run	PW	Riffle	Length
Clearwater River drainage							
SF Red River	7/09/93	Mouth—Trapper Creek	4.1	39.6	20.1	36.2	4.70
		Trapper Creek—WF SF Red R	10.0	45.2	14.1	30.7	6.90
		Mouth—WF SF Red R.	7.6	43.0	16.5	32.9	11.60
Gedney Creek	7/25/94	Mouth—WF Gedney Creek	7.4	19.3	59.0	14.3	5.02
	7/23/95	WF Gedney—first LB upst trib.	7.3	13.6	75.1	4.0	1.33
		Mouth—first trib upst WF Gedney	7.4	18.1	62.4	12.1	6.32
WF Gedney Creek	7/22/94	Mouth—waterfall	20.6	19.1	54.5	5.7	2.09
Fish Creek—1994	9/25/94	Mouth—Pagoda Creek	7.6	25.9	59.3	7.3	3.44
	9/25/94	Pagoda Creek—Hungery Creek	6.2	35.7	31.3	26.8	4.03
	9/25/94	Mouth—Hungery Creek	6.8	31.2	44.2	17.8	7.47
Fish Creek—1995	9/13/95	Mouth—Pagoda Creek	6.5	26.4	63.2	4.0	3.98
	9/13/95	Pagoda Creek—Hungery Creek	3.4	20.9	56.5	19.1	4.46
	9/13/95	Mouth—Hungery Creek	4.9	23.5	59.7	12.0	8.43
Salmon River drainage							
Beaver Creek	7/20/93	Mouth—water diversion pump	5.4	73.1	0.0	21.5	1.90
		Diversion—top supple. section	8.8	56.1	5.3	29.8	2.90
		Supple. site-upstream	32.3	47.9	2.1	17.7	8.40
		Mouth—upst about 12.6 km	24.1	52.4	2.6	20.9	12.60
Frenchman Creek	7/20/93	Mouth—top supple. site	7.1	75.5	2.3	15.1	3.10
		Supple. site—upstream	24.4	65.1	1.0	9.5	3.10
		Mouth—upst 6.2 km	15.7	70.4	1.6	12.3	6.20
West Pass Creek	6/26/93	Mouth—Roaring Creek	3.4	19.7	10.3	66.5	2.30
		Roaring Ck.—Cougar Canyon	4.7	32.8	9.4	53.0	4.70
		Mouth—Cougar Canyon Creek	4.3	28.5	9.7	57.5	7.00
Germania Creek	6/27/93	Upper meadow—Chamberlain Ck	5.4	24.3	25.3	44.8	3.00
Marsh Creek	8/23/94	Mouth—trailhead	3.3	38.8	8.2	49.9	6.91
		Trailhead—Capehorn Creek	1.1	50.9	2.0	46.3	2.85
		Mouth—Capehorn Creek	2.5	42.3	6.4	48.9	9.76

Table 4. Streams and strata boundaries that were snorkeled in 1995. In streams with more than one strata, the downstream boundary of strata 2 and strata 3 begins at the upstream boundary of the previous strata. Crews also snorkeled East Fork Basin Creek and West Fork of the South Fork Red River from their mouth upstream 1 km.

		Boundary	
Stream	**Strata**	**Downstream**	**Upstream**
Fish Creek	1	mouth	Hungery Creek
Gedney Creek	1	mouth	West Fork Gedney Creek
	2	--	Canteen Creek
West Fork Gedney Creek	1	mouth	Waterfall upstream about 2 km
South Fork Red River	1	mouth	Trapper Creek
	2		West Fork Red River
	3		USFS road 1194
Trapper Creek	1	mouth	upstream 1.5 km
Basin Creek	1	mouth	East Fork Basin Creek
Beaver Creek	1	mouth	Irrigation pump about 0.5 km upstream of Highway 75
	2	--	Jeep trail crossing about 3 km upstream of irrigation pump
	3	--	Upstream about 5 km
Frenchman Creek	1	mouth	3 km upstream of mouth in the first meadow section
	2		Upstream 3 km
Marsh Creek	1	mouth	Capehorn Creek
West Pass Creek	1	mouth	Roaring Creek
	2	--	Cougar Canyon Creek

Table 5. Mean fish densities (fish/100 m^2) by habitat type in Salmon River tributaries obtained from snorkel surveys in 1995. S = stream strata; Area = total surface area of all sites in m^2; N = number of sites snorkeled of each habitat type; Trout fry = all trout (except brook trout) ≤75 mm; SH 1 = juvenile steelhead 76 mm to 127 mm; SH 2+ = juvenile steelhead >127 mm; CH 0 = age 0 chinook salmon; CH 1 = age-1 chinook salmon; Cutt = all cutthroat trout; Bull = all bull trout; Brook fry = all brook trout <75 mm; Brook = all brook trout ≥75 mm; White = all mountain whitefish; Total = total salmonid density.

Stream	Date	Habitat Type	S	Area	N	Trout Fry	SH 1	SH 2+	CH 0	CH 1	Cutt	Bull	Brook Fry	Brook	White	Total
Basin Creek	8/6-7	PL	1	267	2	11.42	8.96	2.35	0.60	0.60	0.60	0.87	0.00	0.00	4.19	29.58
		PW	1	307	2	5.71	2.58	3.05	0.00	0.00	0.00	0.71	0.00	0.00	0.71	12.75
		RI	1	1,932	11	0.87	1.54	0.78	0.00	0.08	0.08	0.04	0.05	0.00	0.59	4.03
		RU	1	1,070	10	1.93	2.17	2.77	0.00	0.00	0.00	0.00	0.00	0.00	0.63	7.50
Beaver Creek	8/3	PL	1	190	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.97	0.00	0.00	1.97
		RI	1	452	4	0.21	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.55
		RU	1	850	6	0.07	2.86	0.18	0.00	0.00	0.00	0.00	0.18	1.41	0.00	4.68
Beaver Creek	8/3	PL	2	61	2	0.00	22.19	0.00	1.35	0.00	0.00	0.00	0.00	4.83	0.00	28.37
		PW	2	105	2	0.00	4.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.28
		RI	2	91	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		RU	2	897	10	0.57	3.48	0.30	0.82	0.00	0.00	0.00	0.00	1.68	0.00	6.85
Beaver Creek	8/3	PL	3	445	5	0.30	0.00	0.00	0.76	0.00	0.00	0.00	0.00	4.77	0.00	5.83
		RI	3	630	5	0.22	0.00	0.00	0.66	0.00	0.00	0.00	0.58	0.58	0.00	2.04
		RU	3	790	7	0.43	0.06	0.00	2.78	0.00	0.00	0.00	2.00	5.72	0.00	10.99
EF Basin Creek	8/7	PW	1	59	1	0.00	1.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.68
		RI	1	42	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Frenchman Creek	8/4	PL	1	127	5	0.57	9.10	0.00	41.87	2.85	0.00	0.00	16.43	20.57	0.53	91.92
		PW	1	29	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		RI	1	163	4	1.90	0.00	0.00	8.26	0.00	0.00	0.00	0.00	0.00	0.00	10.16
		RU	1	747	17	0.81	3.02	0.00	0.26	0.00	0.00	0.00	0.13	6.66	0.00	10.88
Frenchman Creek	8/4	PL	2	140	4	0.00	0.00	0.00	11.06	1.93	0.00	0.00	10.49	27.38	0.00	50.85
		RI	2	290	6	0.00	0.37	0.00	0.28	0.00	0.00	0.00	0.00	2.79	0.00	3.44
		RU	2	522	10	0.00	0.00	0.00	15.63	0.00	0.58	0.00	2.51	16.38	0.00	35.10

Table 5. Continued.

Stream	Date	Habitat Type	S	Area	N	Trout Fry	SH 1	SH 2+	CH 0	CH 1	Cutt	Bull	Brook Fry	Brook	White	Total
Marsh Creek	8/5	PL	1	381	1	0.26	0.00	1.05	5.25	0.00	0.26	0.00	0.00	0.00	5.51	12.33
		PW	1	797	1	0.00	0.75	0.88	0.38	0.00	0.13	0.00	0.00	0.00	0.00	2.13
		RI	1	1,334	2	0.00	0.33	0.29	0.09	0.00	0.00	0.00	0.00	0.00	0.66	1.35
		RU	1	915	2	0.30	0.15	0.60	0.32	0.00	0.17	0.00	0.00	0.09	2.23	3.86
West Pass Creek	8/8	PL	1	120	2	0.00	0.00	0.00	0.00	0.00	0.00	3.15	0.00	0.00	0.00	3.15
		PW	1	613	4	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	0.00	0.58
		RI	1	684	5	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.13
		RU	1	314	4	0.00	0.00	0.00	0.00	0.00	0.00	1.52	0.00	0.00	0.78	2.30
West Pass Creek	8/8	PL	2	43	1	0.00	0.00	0.00	0.00	0.00	0.00	4.67	0.00	0.00	0.00	4.67
		PW	2	102	1	0.00	0.00	0.00	0.00	0.00	0.00	0.98	0.00	0.00	0.00	0.98
		RI	2	432	4	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.00	0.00	0.00	0.22

Table 6. Mean fish densities (fish/100 m^2) by habitat type in Clearwater River tributaries obtained from snorkel surveys in 1995. S = stream strata; Area = total surface area of all sites in m^2; N = number of sites snorkeled of each habitat type; Trout fry = all trout (except brook trout) ≤75 mm; SH 1 = juvenile steelhead 76 mm to 127 mm; SH 2+ = juvenile steelhead >127 mm; CH 0 = age 0 chinook salmon; CH 1 = age-1 chinook salmon; Cutt = all cutthroat trout; Bull = all bull trout; Brook fry = all brook trout <75 mm; Brook =all brook trout ≥75 mm; White = all mountain whitefish; Total = total salmonid density.

Stream	Date	Habitat Type	S	Area	N	Trout Fry	SH 1	SH 2+	CH 0	CH 1	Cutt	Bull	Brook Fry	Brook	White	Total
Fish Creek	7/6-10	PL	1	860	4	1.19	14.03	11.40	0.00	0.00	0.69	0.00	0.00	0.00	0.18	27.48
		PW	1	8,716	15	0.51	6.83	3.62	0.00	0.00	0.15	0.00	0	0.00	0.04	11.15
		RI	1	1,603	4	0.29	4.57	2.60	0.00	0.00	0.23	0.00	0	0.00	0.00	7.69
		RU	1	1,526	5	1.00	9.32	4.55	0.00	0.00	0.31	0.00	0	0.00	0.00	15.17
Fish Creek	8/20-22	PL	1	1,270	7	5.26	22.81	12.23	0.00	0.09	1.17	0.00	0	0.00	0.09	41.67
		PW	1	9,934	21	3.13	8.06	7.09	0.00	0.00	0.13	0.01	0	0.00	0.04	18.46
		RI	1	2,584	6	6.44	4.95	2.39	0.00	0.00	0.18	0.00	0	0.00	0.00	13.98
		RU	1	3,254	15	9.08	14.91	10.98	0.00	0.00	0.76	0.00	0	0.00	0.05	35.80
Gedney Creek	7/21-25	PL	1	672	5	5.46	10.90	10.2	0.22	0.22	0.32	0.00	0	0.00	0.79	28.10
		PW	1	8,522	22	5.25	5.88	5.07	0.03	0.00	0.04	0.01	0	0.00	0.14	16.42
		RI	1	1,407	5	6.23	5.15	1.80	0.00	0.00	0.00	0.00	0	0.00	0.15	13.32
		RU	1	2,280	13	10.47	6.97	7.11	0.00	0.09	0.32	0.00	0	0.00	0.32	25.27
Gedney Creek	7/20 & 22	PL	2	119	3	0.69	13.42	20.15	0.00	0.00	0.00	0.00	0	0.00	0.00	34.26
		PW	2	845	7	4.17	7.06	5.81	0.00	0.00	0.00	0.00	0	0.00	0.00	17.04
		RI	2	72	1	0.00	5.58	4.19	0.00	0.00	0.00	0.00	0	0.00	0.00	9.77
		RU	2	227	3	8.11	11.8	10.56	0.00	0.00	0.00	0.00	0	0.00	0.00	30.47
WF Gedney Creek	7/20 & 22	PL	1	389	3	18.11	17.29	13.90	0.00	0.18	1.12	0.18	0	0.00	0.18	50.95
		PW	1	1,230	6	8.90	8.91	7.38	0.00	0.00	0.11	0.00	0	0.00	0.07	25.36
		RI	1	549	2	18.16	6.93	4.57	0.00	0.00	0.00	0.00	0	0.00	0.00	29.66
		RU	1	479	3	7.34	9.95	8.41	0.00	0.17	0.00	0.00	0	0.00	0.00	25.88

Table 6. Continued.

Stream	Date	Habitat Type	S	Area	N	Trout Fry	SH 1	SH 2+	CH 0	CH 1	Cutt	Bull	Brook Fry	Brook	White	Total
SF Red River	6/27-28	PL	1	444	6	0.00	3.52	1.95	1.61	0.00	3.45	0.00	0	2.10	0.54	13.18
		W	1	779	5	0.00	2.66	0.80	0.00	0.00	1.02	0.00	0	0.00	0.00	4.47
		RI	1	1,110	8	0.00	1.94	1.04	0.38	0.00	0.54	0.00	0	0.42	0.13	4.46
		RU	1	1,129	8	0.00	5.32	1.64	2.72	0.00	3.81	0.00	0	0.09	0.21	13.78
SF Red River	6/27-28	PL	2	226	3	0.00	3.32	2.30	0.00	0.00	0.86	0.00	0	2.30	0.00	8.79
		PW	2	272	3	0.00	0.71	1.38	0.00	0.00	0.34	0.00	0	0.00	0.00	2.43
		RI	2	838	11	0.00	1.79	0.33	0.00	0.00	0.00	0.00	0	0.11	0.11	2.35
		RU	2	1,276	18	0.20	2.50	0.75	0.00	0.00	0.89	0.00	0	0.35	0.14	4.82
SF Red River	6/28	RI	3	61	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
		RU	3	26	1	0.00	7.56	3.78	0.00	0.00	0.00	0.00	0	0.00	0.00	11.34
WF SF Red River	6/28	RI	1	37	1	0.00	0.00	2.67	0.00	0.00	0.00	0.00	0	0.00	0.00	2.67
		RU	1	65	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
Trapper Creek	6/28	PW	1	45	1	0.00	8.93	0.00	0.00	0.00	6.70	0.00	0	0.00	0.00	15.62
		RI	1	36	1	0.00	11.24	0.00	0.00	0.00	8.43	0.00	0	0.00	0.00	19.68
		RU	1	33	1	0.00	9.03	3.01	0.00	0.00	24.08	0.00	0	0.00	0.00	36.12

Table 7. The weighted mean density (fish/100 m^2) in each stream strata that was snorkeled in 1995. Trout fry = all trout (except brook trout) ≤75 mm; SH 1 = juvenile steelhead 76 mm to 127 mm; SH 2+ = juvenile steelhead >127 mm; CH 0 = age 0 chinook salmon; CH 1 = age-1 chinook salmon; Cutt = all cutthroat trout; Bull = all bull trout; Brook fry = all brook trout <75 mm; Brook =all brook trout ≥75 mm; White = all mountain whitefish; Total = total salmonid density.

Stream	**Strata**	**Trout Fry**	**SH 1**	**SH 2+**	**CH 0**	**CH 1**	**Cutt**	**Bull**	**Brook Fry**	**Brook**	**White**	**Total**
Fish Creek-July	1	0.63	7.50	4.10	0.00	0.00	0.22	0.00	0.00	0.00	0.03	12.49
Fish Creek-August	1	5.03	10.03	7.70	0.00	0.00	0.34	0.01	0.00	0.00	0.04	23.15
Gedney Creek	1	6.41	6.36	5.38	0.03	0.03	0.11	0.01	0.00	0.00	0.22	18.55
	2	4.29	8.11	7.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.83
WF Gedney Creek	1	11.02	10.71	8.75	0.00	0.07	0.29	0.04	0.00	0.00	0.08	30.95
SF Red River	1	0.00	3.50	1.25	1.35	0.00	2.16	0.00	0.00	0.27	0.17	8.69
	2	0.09	2.11	0.86	0.00	0.00	0.54	0.00	0.00	0.42	0.10	4.12
	Both	0.05	2.67	1.02	0.55	0.00	1.20	0.00	0.00	0.36	0.13	5.97
Beaver Creek	1	0.10	2.09	0.17	0.00	0.00	0.00	0.00	0.24	1.07	0.00	3.65
	2	0.32	4.13	0.17	0.58	0.00	0.00	0.00	0.00	1.37	0.00	6.57
	3	0.35	0.03	0.00	1.73	0.00	0.00	0.00	1.08	4.49	0.00	7.68
Frenchman Creek	1	0.94	2.93	0.00	4.42	0.20	0.00	0.00	1.26	6.49	0.04	16.27
	2	0.00	0.04	0.00	13.06	0.47	0.38	0.00	4.22	17.77	0.00	35.94
West Pass Creek [a]	1	0.00	0.00	0.00	0.00	0.00	0.00	0.55	0.00	0.00	0.15	0.71
	2	0.00	0.00	0.00	0.00	0.00	0.00	1.96	0.00	0.00	0.00	1.96
Marsh Creek	1	0.13	0.27	0.48	0.33	0.00	0.09	0.00	0.00	0.04	1.40	2.74

[a] No runs where snorkeled in strata 2. I assumed that run density equaled pool density to calculate the average.

Population Totals

The largest populations of steelhead parr were found in the Fish and Gedney drainages (Table 8). I estimated the age-1 and age-2+ populations were 9,196 (95% CI ±2,507) and 7,154 (95% CI ±1,846), respectively, in Fish Creek. The Gedney Creek and West Fork Gedney Creek age-1 and age-2+ populations, when combined, were 7,077 (95% CI ±1,166) and 5,901 (95% CI ±1,257), respectively.

In the Salmon River drainage, the steelhead populations were less than 800 fish in Beaver and Frenchman creeks and zero in West Pass Creek. I did not estimate the population in Marsh Creek because of the small number of sites that were snorkeled. The Basin Creek population was not calculated because a habitat survey was not done in this stream.

Table 8. Population totals for age-1 and age-2+ steelhead and the 95% bound on the population estimate (in parentheses).

Stream	Strata	Age-1	Age-2+
Salmon River drainage			
Beaver Creek	1	177 (132)	28 (7)
Beaver Creek	2	543 (257)	23 (32)
Beaver Creek	3	8 (17)	0
Beaver Creek	All	728 (406)	51 (49)
Frenchman Creek	1	274 (146)	0
Frenchman Creek	2	4 (6)	0
Frenchman Creek	All	278 (152)	0
West Pass Creek	1	0	0
West Pass Creek	2	0	0
West Pass Creek	All	0	0
Clearwater River drainage			
Fish Creek (August)	1	9,196 (2,507)	7,154 (1,846)
Gedney Creek	1	3,996 (589)	3,276 (454)
Gedney Creek	2	1,139 (266)	1,043 (441)
Gedney Creek	All	5,135 (855)	4,319 (895)
West Fork Gedney Creek	1	1,942 (311)	1,582 (362)
South Fork Red River	1	1,154	409
South Fork Red River	2	652	224
South Fork Red River	All	1,806	633

Stream Temperature

The regression of TU on elevation was significant (Figure 9) when the data from streams in the Clearwater and Salmon river drainages were combined ($p < 0.001$, $r^2 = 0.54$, df = 24). The regression was also significant when done by drainage and the slope of the Salmon River relation was steeper than that of the Clearwater River drainage.

I had temperature data from May 1 through October 15 for 1994 and 1995 in 14 streams. For this period, the amount of TU accrued declined in 1995 compared to 1994 in all streams. The largest decline of 28.3% was in the East Fork Salmon River at Bowery and the lowest decline (8.8%) was in Weir Creek. The largest TU decline occurred in the Salmon River tributaries (Table 9).

Graphs of the daily mean, minimum, and maximum stream temperatures can be found in Appendices 1 through 35.

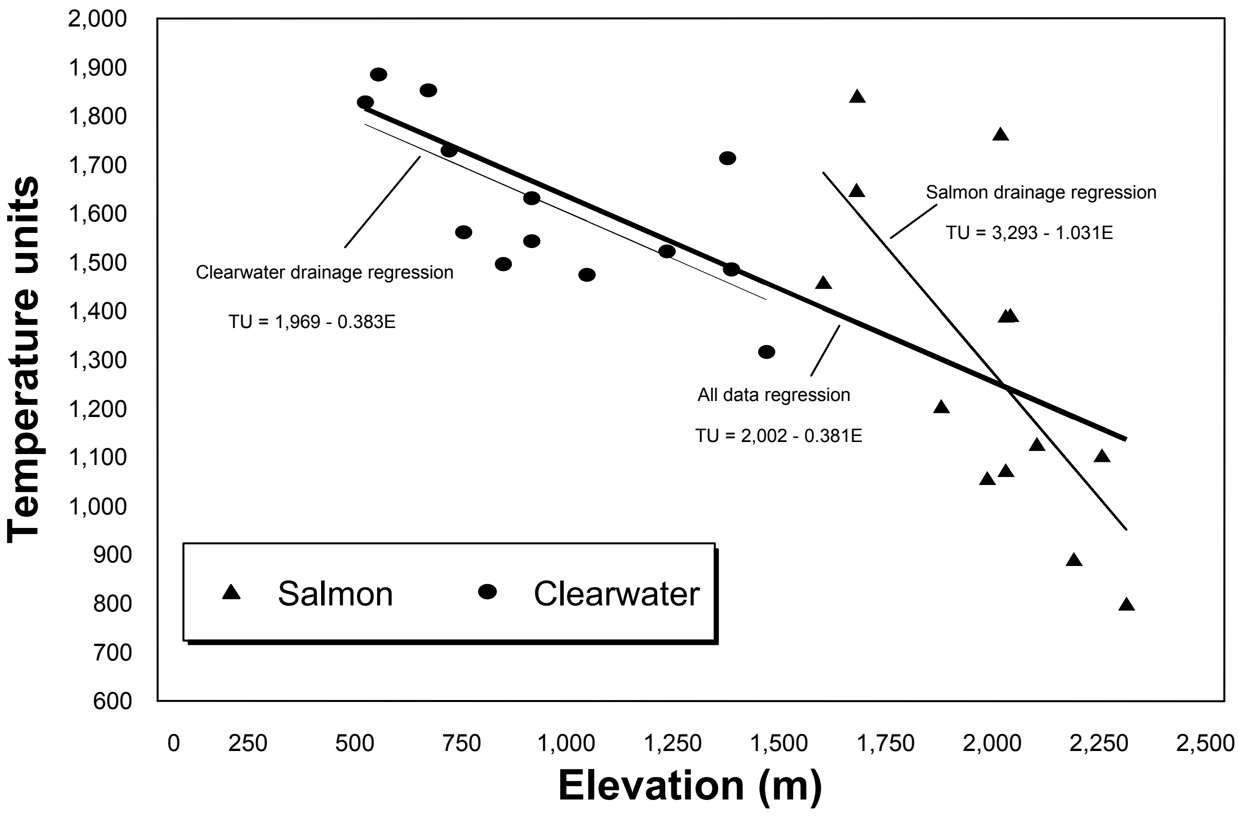


Figure 9. The relationship between elevation (E) and temperature units (TU) accrued from May 1 to October 15 in tributaries of the Salmon and Clearwater river drainages. The regressions of all data points ($p<0.001$, $r^2 = 0.54$), the Clearwater River tributaries ($p = 0.006$, $r^2 = 0.51$), and the Salmon River tributaries ($p = 0.004$, $r^2 = 0.54$) were all significant.

Table 9. Streams used in the regression of temperature units from May 1 to October 15, 1995 and elevation.

Stream	Temperature units accumulated from 1/1-12/31/95	5/1-10/15/95	5/1-10/15/94	Elevation (meters)	Percent change
Salmon River drainage					
Basin Creek [a]	1,287	1,206		1,838	
Beaver Creek	1,778	1,105	1,485	2,213	-25.6
Capehorn Creek	1,259	1,074		1,987	
Fourth of July Creek	1,082	892		2,149	
East Fork Salmon at Bowery	1,841	1,128	1,574	2,060	-28.3
East Fork Salmon at mouth	2,221	1,649	2,015	1,639	-18.2
Germania Creek	1,317	1,058	1,325	1,945	-20.1
Marsh Creek	1,686	1,391	1,643	1,987	-15.3
Pole Creek[b]	1,202	823		2,271	
Salmon River at East Fork	2,281	1,842	2,063	1,640	-10.7
Salmon River at Sawtooth	2,343	1,764	2,034	1,975	-13.2
South Fork Salmon at Knox Bridge	1,708	1,460	1,911	1,561	-23.1
Clearwater River drainage					
Bald Mountain Creek		1,563		716	
Canyon Creek	2,422	1,829		488	
Crooked Fork Creek	1,834	1,231	1,721	1,195	-11.4
Fish Creek at mouth[c]	2,336	1,853	2,153	634	-13.9
Gedney Creek	2,512	1,886			
Lost Creek	1,965	1,498		811	
Post Office Creek	2,011	1,544	1,695	878	- 8.9
Red River	1,878	1,714	1,894	1,335	- 9.5
SF Red River at Schooner Creek	1,640	1,486	1,689	1,344	-12.0
Trapper Creek	1,452	1,317		1,427	
Weir Creek	2,165	1,632	1,790	878	- 8.8
Wendover Creek[c]	1,931	1,476		1,006	
West Fork Gedney Creek	2,287	1,730		683	

[a] Recorder lost during the 1995-1996 winter. Temperature units in first column accrued from January 1, 1995 to October 27, 1995.
[b] Mean temperature estimated from June 16 to June 20.
[c] Recorder at the mouth of Fish Creek was lost in the November 1995 flood. Temperatures from November 4 to December 31 obtained from a recorder 3.5 km upstream from the mouth.

PIT Tagging

We trapped 1,257 steelhead and tagged 1,126 fish at the six screw trap sites in the spring of 1995. We trapped 473 and tagged 463 fish at Fish Creek, the most at any location. We captured and tagged 50 fish at the East Fork Salmon River trap (Table 10, Figures 10-15), the lowest number at any site during the spring. The mean length of the tagged fish ranged from 175 mm at Crooked Fork Creek to 100 mm at the South Fork Salmon River (Table 10, Figures 16-21). The condition factor of the fish ranged from 1.1227 at the South Fork Salmon River to 0.8828 at Crooked Fork Creek (Table 10).

There was a significant difference in steelhead fork lengths among the streams (ANOVA, df = 5, $p<0.001$). Tukey's HSD multiple comparison test revealed that there were significant differences in fish length between Crooked Fork Creek, Fish Creek, Pahsimeroi River, and all other streams (Table 11). All other pairwise comparisons were insignificant, although the comparisons between East Fork Salmon River and South Fork Salmon River approached significance ($p = 0.066$).

There was a significant difference among the streams in fish condition factor (ANOVA, df = 5, $p<0.001$). Crooked Fork Creek and the South Fork Salmon River differed from all other streams (Table 12).

During the spring trapping season, we caught >100 fish at all screw trap sites except the EF Salmon River. The earliest migrants leaving the streams, based on trap date, were from Crooked Fork Creek and Marsh Creek. The median migration dates were April 24 and 26 in Marsh Creek and Crooked Fork Creek, respectively (Table 13, Figure 22a). In the South Fork Salmon River and Pahsimeroi River the fish moved later, as the median migration dates were attained on May 13 and 18, respectively. In Fish Creek, the migration mimicked that of the South Fork Salmon River and Pahsimeroi River until May 10. From then until May 30, five fish left the creek. Beginning in early June, large numbers of fish were trapped daily, and the median trapping date was attained on June 8. This late migration, over a two-week period, comprised over 70% of the fish trapped during the spring and was made up of parr that averaged 122 mm. Only eight of the 376 fish we trapped in Fish Creek after June 1 were detected at the downstream dams as smolts in 1995.

During July 1995, we collected 435 and 379 steelhead parr in Fish and Gedney creeks, respectively. We returned to both creeks later in the summer and collected an additional 296 fish in Gedney Creek on August 18 and 19 and 368 fish in Fish Creek on September 2, 3, and 4. In Fish Creek, there was a significant increase in parr length (t-test, df = 776, $p<0.001$) from 142 mm to 149 mm and a significant decline in condition factor (t-test, df = 717, $p<0.001$) from 1.1475 to 1.0135 (Table 10) between the two collection dates. In Gedney Creek, there was a significant increase in parr length (t-test, df = 596, $p<0.001$) from 139 mm to 148 mm and a significant decline in condition factor (t-test, df = 596, $p = 0.002$) from 1.0271 to 1.0058 (Table 10) between the two collection dates.

During the fall, we trapped juvenile steelhead at the spring sites and at Rapid River. I did not include the Rapid River fish in the fall data analysis because we used a weir designed for bull trout to collect the fish and probably selected for larger fish. We caught 1,596 juvenile steelhead and tagged 1,171 at all sites in the fall of 1995. The number of juvenile steelhead trapped ranged from 686 at Crooked Fork Creek to 13 at Pahsimeroi River. We tagged 543 juvenile steelhead at Fish Creek, the most at any site (Table 10).

There was a significant difference in fish length among the streams (ANOVA, df = 5, p <0.001) during the fall. The mean fish length ranged from 159 mm at Crooked Fork Creek to 134 mm at the East Fork Salmon River (Table 10). Tukey's pairwise comparisons revealed differences between: Marsh Creek and all other streams except the East Fork Salmon River; Fish Creek and the Pahsimeroi and South Fork Salmon rivers; and the Pahsimeroi River and the East Fork Salmon River (Table 11).

Marsh Creek was dropped from the condition factor analysis because weights were not measured during the fall. There was a significant difference in fish condition factor among the streams (ANOVA, df = 4, p<0.001) during the fall. Condition factors ranged from 1.0819 at the Pahsimeroi River to 0.9716 at the South Fork Salmon River. There were significant pairwise differences between the Pahsimeroi River and all other sites and between Fish Creek and Crooked Fork Creek (Table 12.)

We caught ≤60 steelhead parr at all screw trap sites during the fall except Fish and Crooked Fork creeks. The earliest median migration date during the fall, based on trap date, was September 3 at the East Fork Salmon River and the latest was October 27 at Pahsimeroi River (Table 13, Figure 22b). In Fish Creek the median migration date was September 17, and 90% of the fish had left by October 2. We only caught five fish in Fish Creek after October 8, although we ran the trap until November 2. In Crooked Fork Creek the median migration date was October 4, and 90% of the fish were caught by October 17.

We trapped and tagged 194 juvenile steelhead at the Rapid River weir between July 26 and November 2. The average steelhead length was 180 mm, and the average K factor was 1.0156 (Table 10, Figure 23a). We trapped 70% of the fish between September 20 and October 8 (Figure 23b).

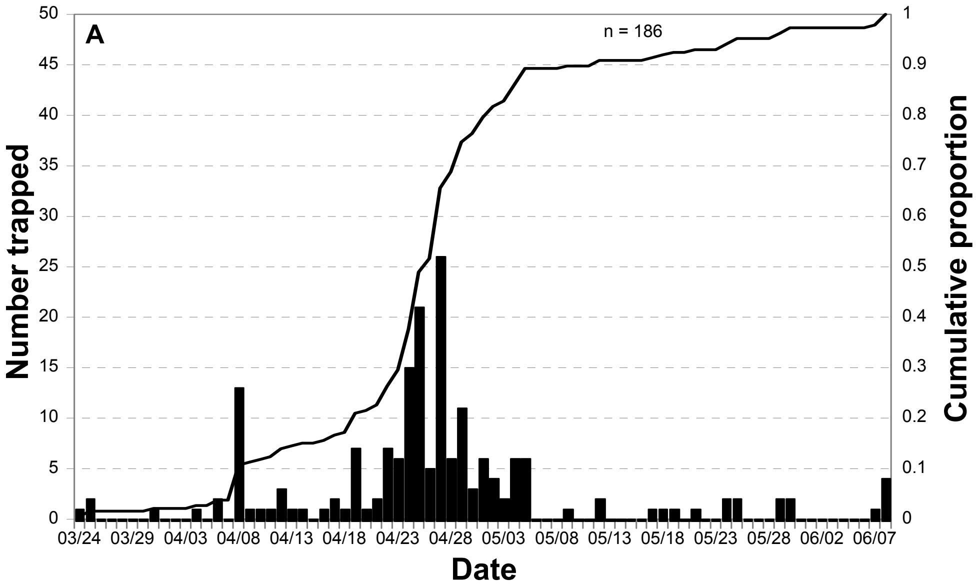
Growth

We recaptured 23 previously PIT-tagged fish from Gedney Creek and 22 from Fish Creek. The mean growth rates were 0.1642 mm/day (95% CI ±0.0309) in Fish Creek and 0.1201 mm/day (95% CI ±0.0162) in Gedney Creek. There was a significant negative correlation between growth rate and length at first capture (r=-0.364, n=45, p=0.014) when data from both streams were combined (Figure 24a). When data were analyzed by stream, the correlation was significant in Gedney Creek (r=-0.494, n=23, p=0.017), but not in Fish Creek (r=-0.218, n=22, p=0.33). There was a significant negative correlation between growth rate and days between capture (r=-0.544, n=43, p<0.001) for all data combined (Figure 24b) and in Fish Creek (r=-0.48, n=22, p=0.024).

Table 10. The number of juvenile steelhead that were collected and PIT tagged, and the mean fork length (mm), weight (g), and condition factor (K), at each site in 1995.

		Number		Median	Mean (SD)			Sample Size	
Site	**Date**	**Collected**	**Tagged**	**Length**	**Length**	**Weight**	**K**	**Length**	**K**
Spring screw traps									
Crooked Fork Creek	3/24-6/8	186	172	182	175 (29)	48.9 (17.2)	0.8828 (0.0782)	174	161
Fish Creek	3/15-6/14	473	464	124	131 (25)	25.4 (15.3)	1.0461 (0.0924)	465	463
East Fork Salmon River	3/7-5/31	50	50	91	113 (42)	20.6 (23.3)	1.0160 (0.1375)	50	50
Marsh Creek	3/24-6/8	138	126	90	103 (35)	14.2 (17.6)	0.9875 (0.2191)	125	122
Pahsimeroi River	3/15-6/16	309	213	138	141 (29)	31.5 (17.9)	1.0284 (0.1128)	213	213
South Fork Salmon River	3/24-6/8	101	101	95	100 (28)	11.5 (9.7)	1.1227 (0.1707)	100	90
Summer stream collection									
Fish Creek	7/8-7/9	435	425	142	142 (25)	36.5 (21.8)	1.1475 (0.0903)	418	368
Fish Creek	9/2-9/4	368	357	148	149 (23)	35.8 (17.9)	1.0135 (0.0631)	360	351
Gedney Creek	7/22-7/23	379	364	138	139 (26)	30.8 (19.3)	1.0271 (0.0810)	366	363
Gedney Creek	8/18-8/19	296	280	146	148 (27)	36.0 (20.9)	1.0058 (0.0804)	243	235
Fall screw traps									
Crooked Fork Creek	8/24-11/4	686	328	159	159 (21)	41.8 (13.6)	0.9773 (0.0503)	297	271
Fish Creek	8/17-11/2	568	543	148	148 (18)	33.7 (12.1)	0.9967 (0.0535)	551	514
East Fork Salmon River	8/15-10/30	20	20	136	134 (23)	23.9 (11.5)	0.9767 (0.2901)	18	18
Marsh Creek	8/24-11/4	60	18	151	148 (21)	--	—	17	0
Pahsimeroi River	9/20-12/5	13	13	134	141 (40)	31.7 (12.8)	1.0819 (0.0792)	13	13
Rapid River[a]	7/26-11/2	194	194	177	180 (21)	56.3 (16.4)	1.0156 (0.1963)	194	181
South Fork Salmon River	8/24-11/4	55	55	147	142 (23)	28.8 (9.3)	0.9716 (0.0393)	55	12

[a] Fish were trapped with a weir.



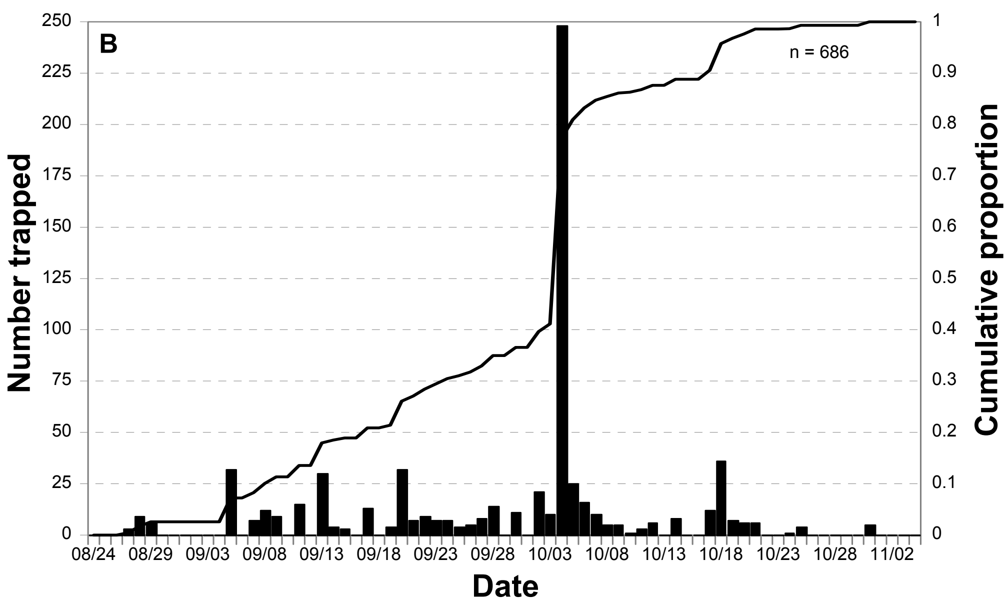


Figure 10. The daily number of juvenile steelhead caught in the Crooked Fork Creek screw trap (bars) and the cumulative distribution (line) of the total trapped. (A) March 24 to June 8, 1995. (B) August 24 to November 4, 1995.

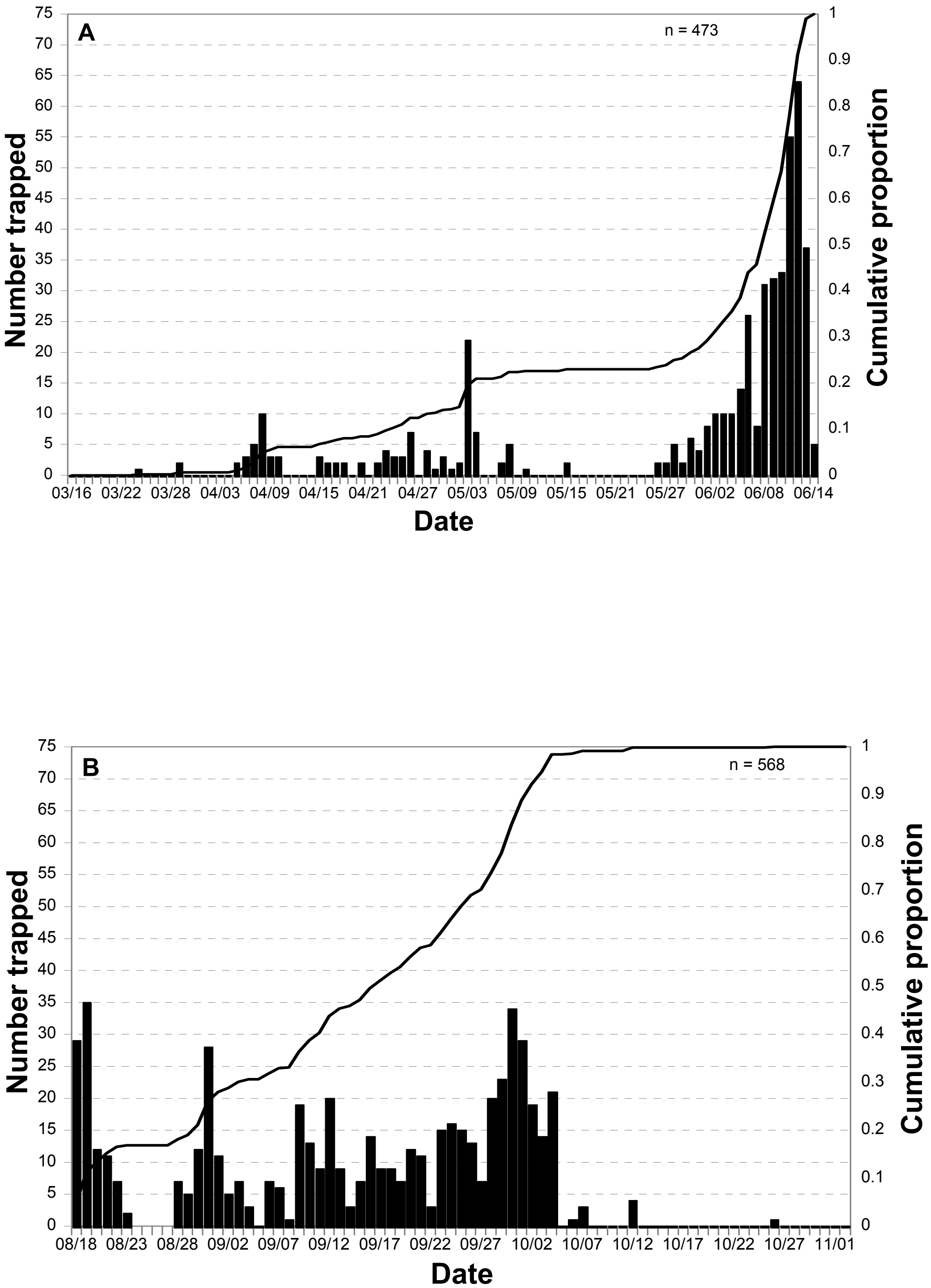
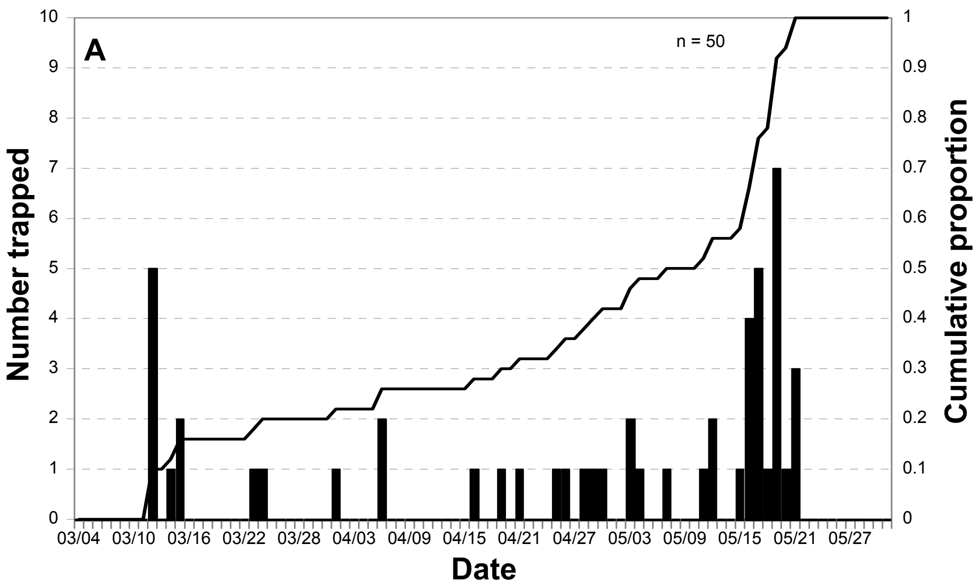


Figure 11. The daily number of juvenile steelhead that were caught in the Fish Creek screw trap (bars) and the cumulative distribution (line) of the total trapped. (A) March 15 to June 14, 1995. (B) August 17 to November 2, 1995.



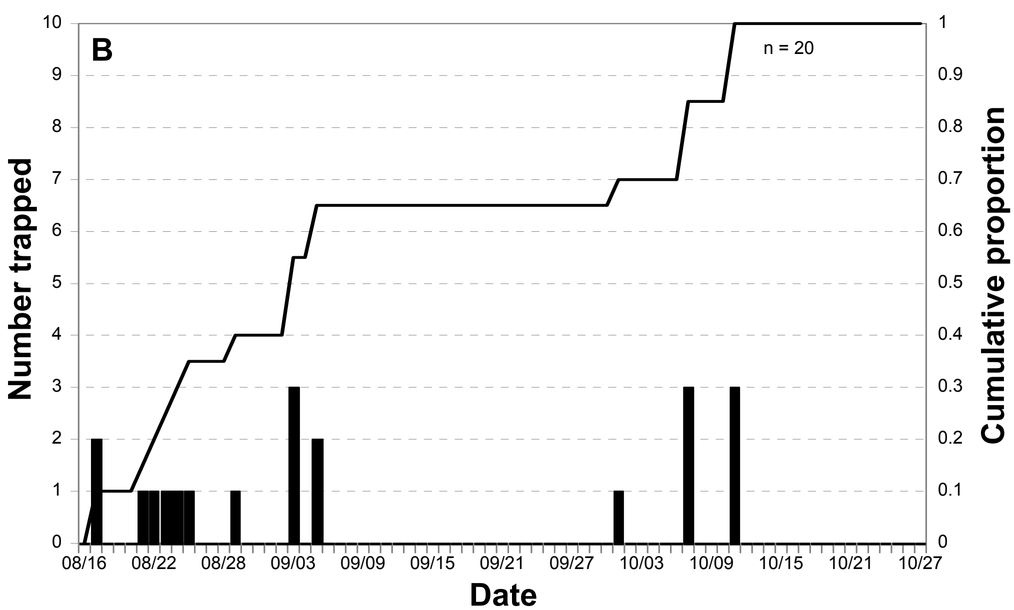


Figure 12. The daily number of juvenile steelhead that were caught in the East Fork Salmon River screw trap (bars) and the cumulative distribution (line) of the total trapped. (A) March 7 to May 31, 1995. (B) August 16 to November 16, 1995.

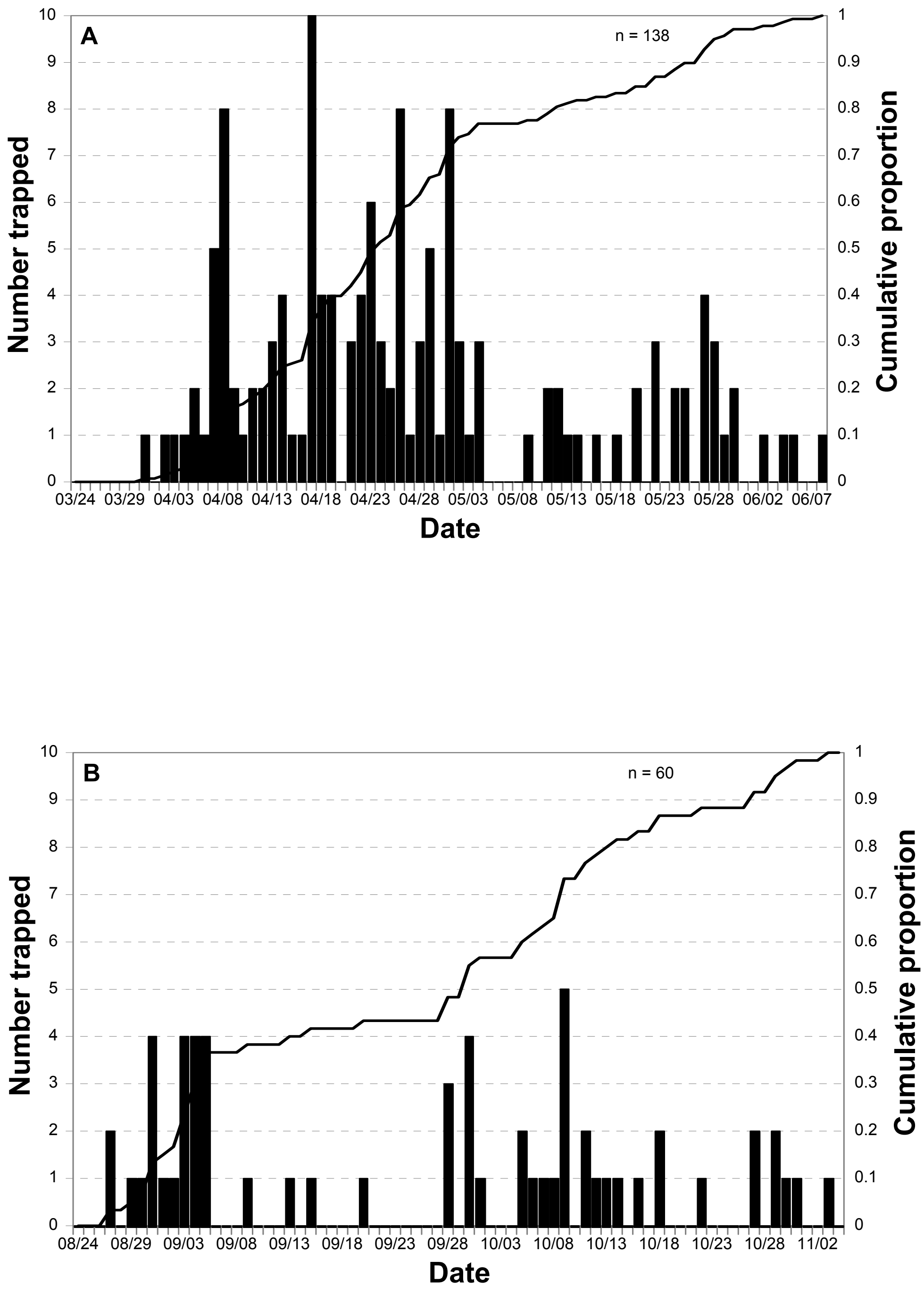
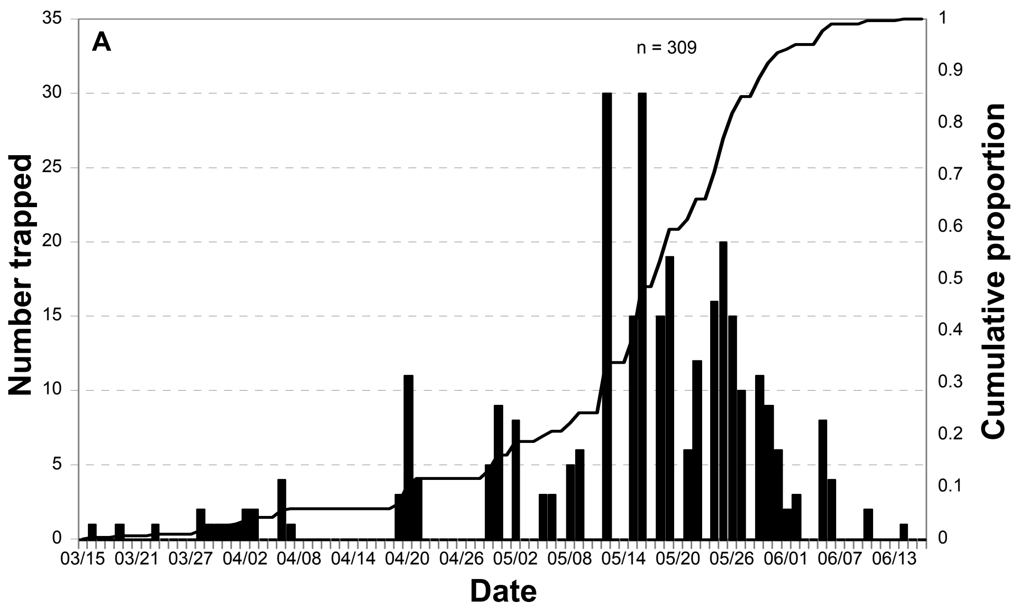


Figure 13. The daily number of juvenile steelhead that were caught in the Marsh Creek screw trap (bars) and the cumulative distribution (line) of the total trapped. (A) March 24 to June 8, 1995. (B) August 24 to November 4, 1995.



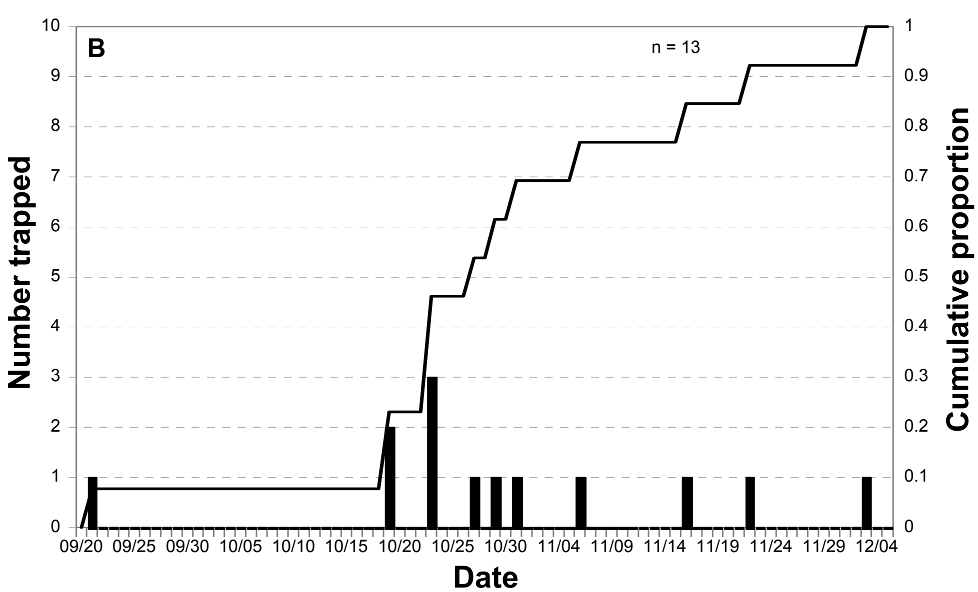


Figure 14. The daily number of juvenile steelhead that were caught in the Pahsimeroi River screw trap (bars) and the cumulative distribution (line) of the total trapped. (A) March 15 to June 16, 1995. (B) September 20 to December 5, 1995.

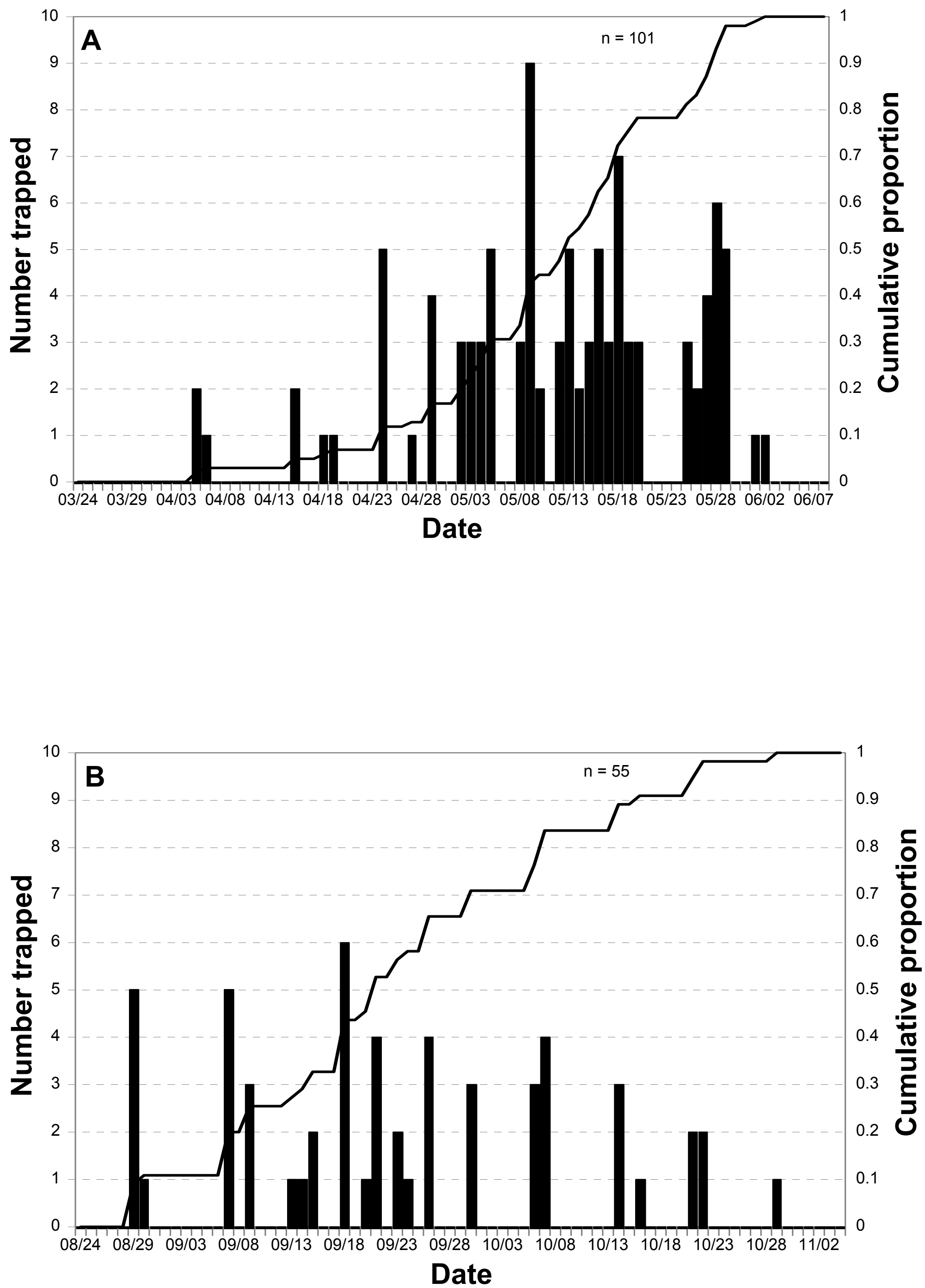


Figure 15. The daily number of juvenile steelhead that were caught in the South Fork Salmon River screw trap (bars) and the cumulative distribution (line) of the total trapped. (A) March 24 to June 8, 1995. (B) August 24 to November 4, 1995.

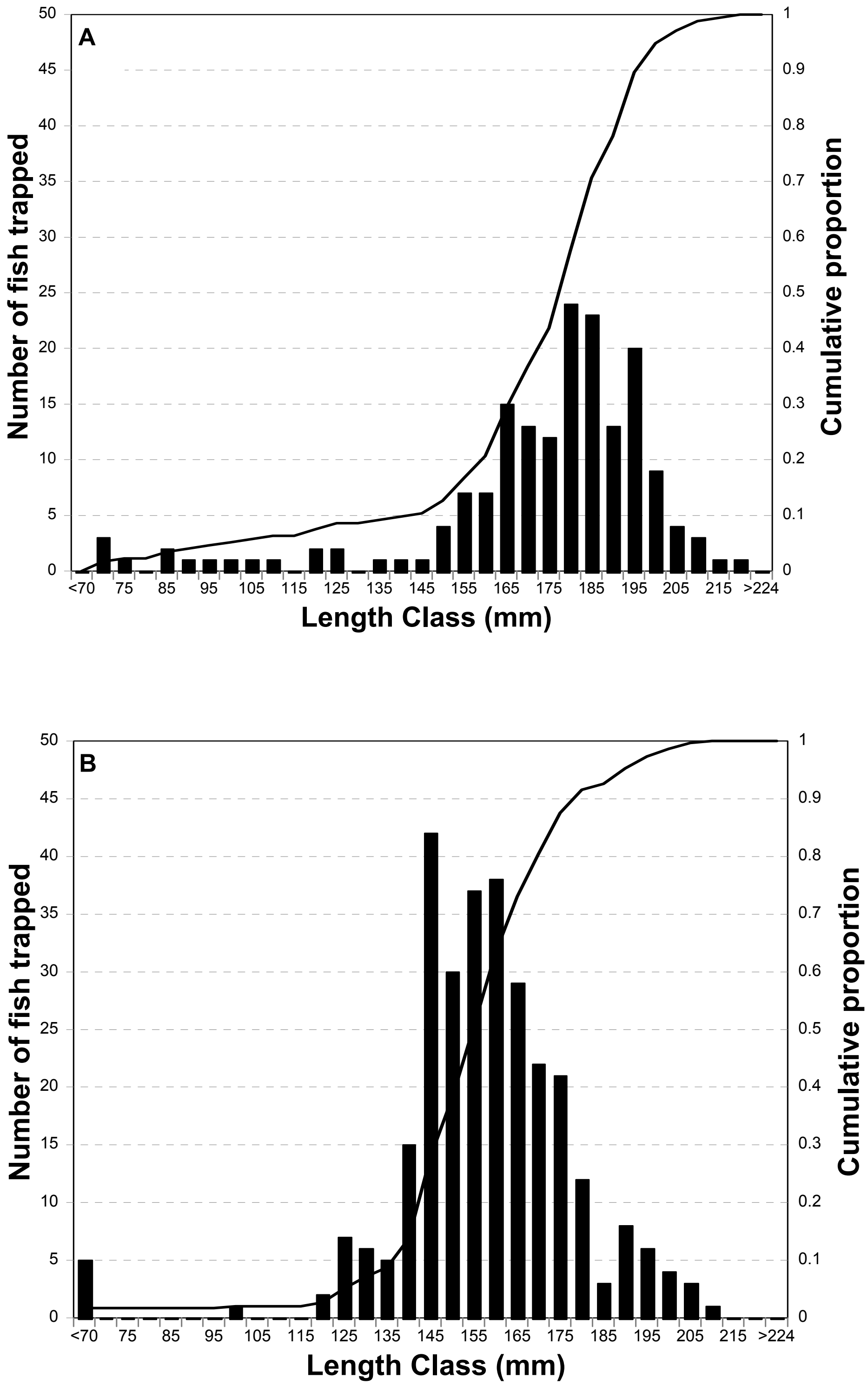


Figure 16. The length frequency of steelhead (bars) and the cumulative distribution (line) of length of those that were PIT tagged at Crooked Fork Creek in 1995. (A) Spring trapping season. (B) Fall trapping season.

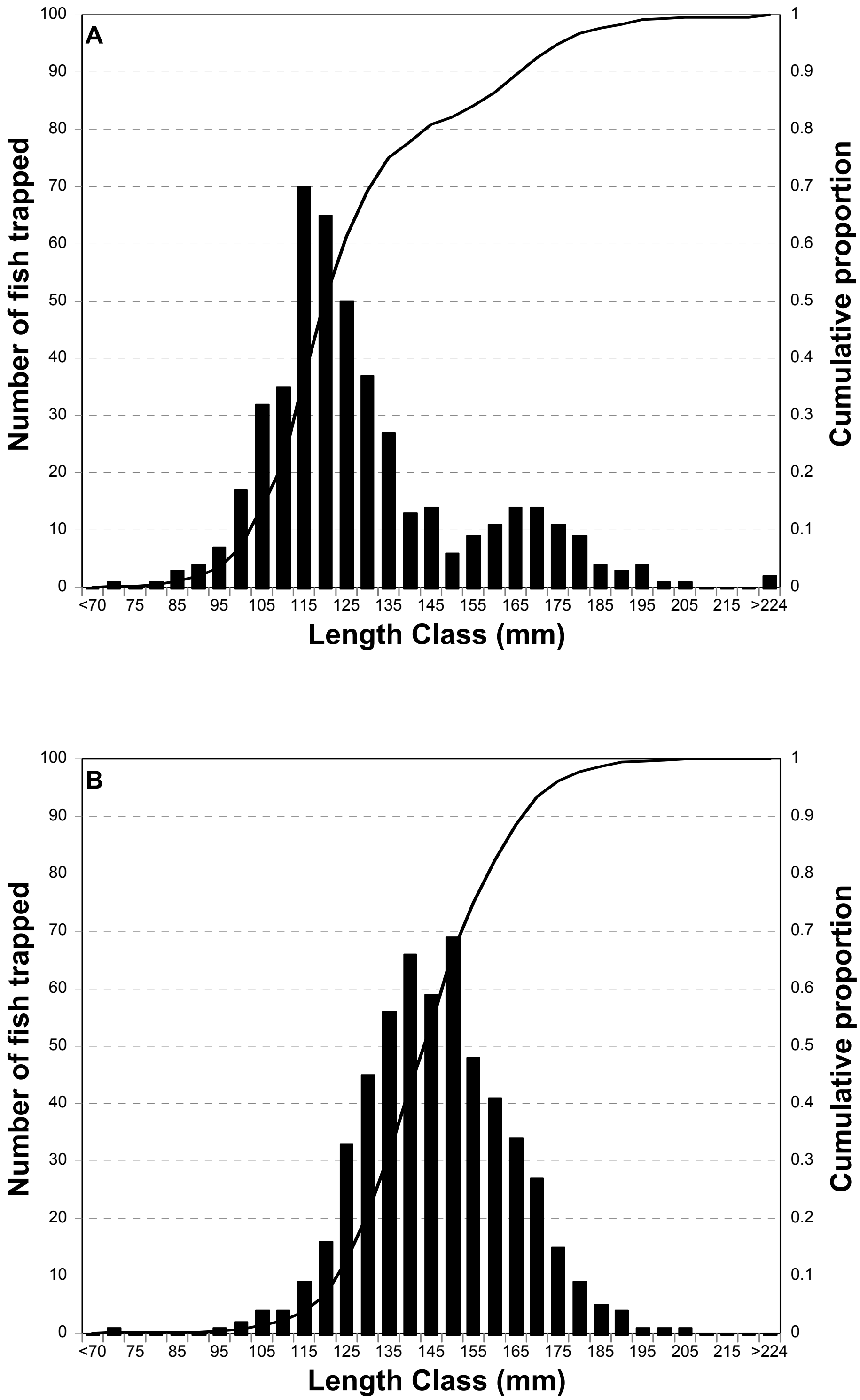
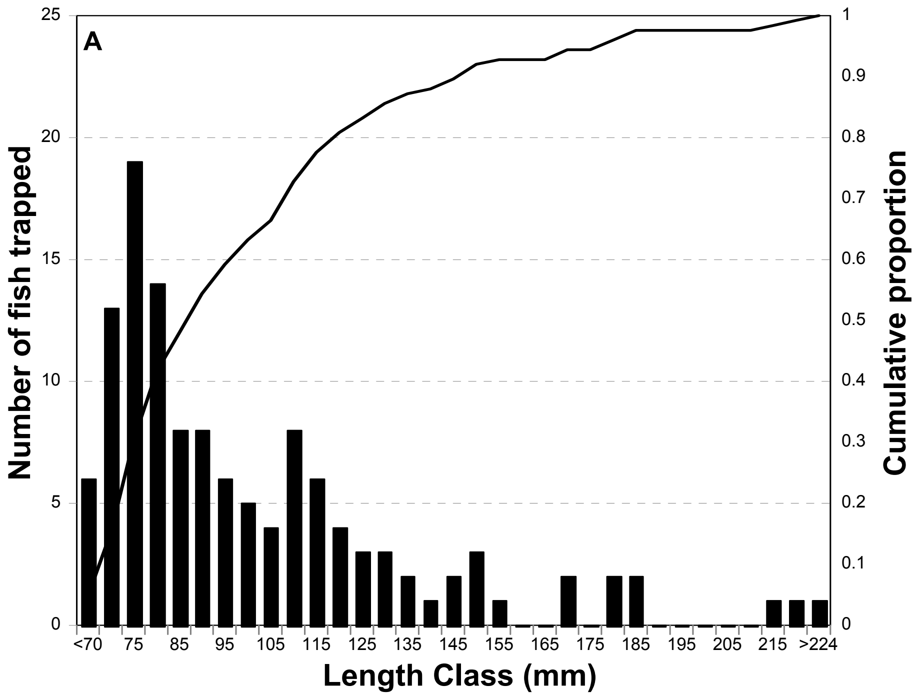


Figure 17. The length frequency of steelhead (bars) and the cumulative distribution (line) of length of those that were PIT tagged at Fish Creek in 1995. (A) Spring trapping season. (B) Fall trapping season.



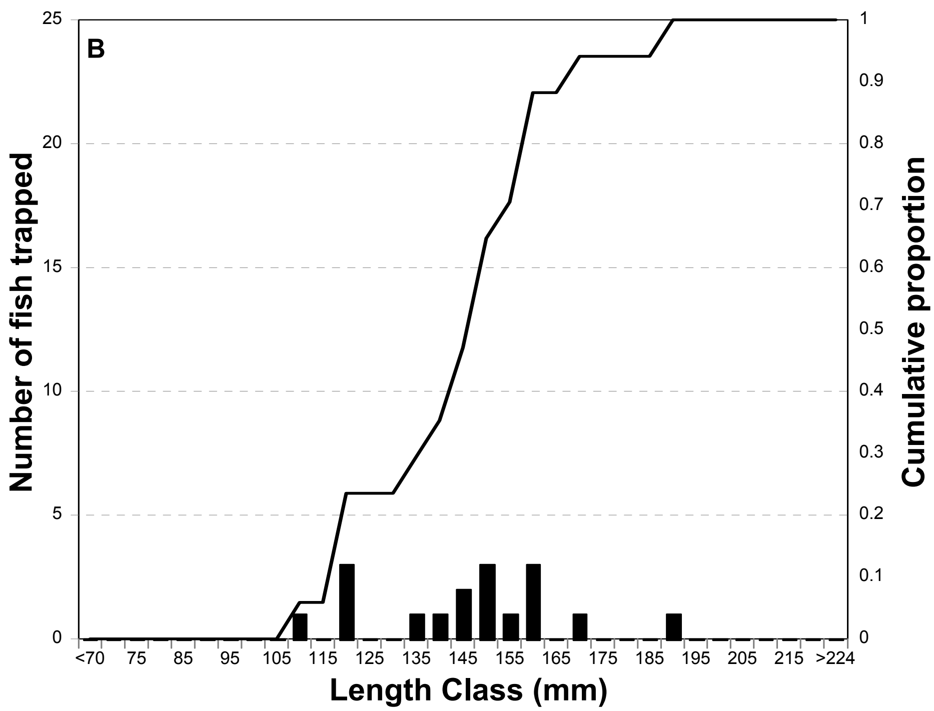
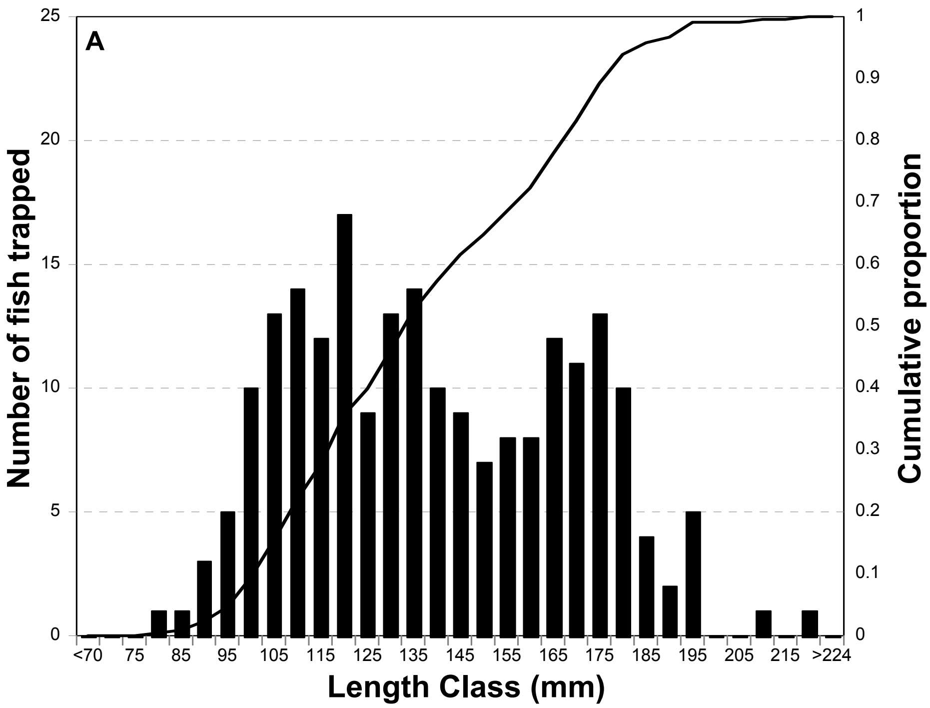


Figure 18. The length frequency of steelhead (bars) and the cumulative distribution (line) of length of those that were PIT tagged at Marsh Creek in 1995. (A) Spring trapping season. (B) Fall trapping season.



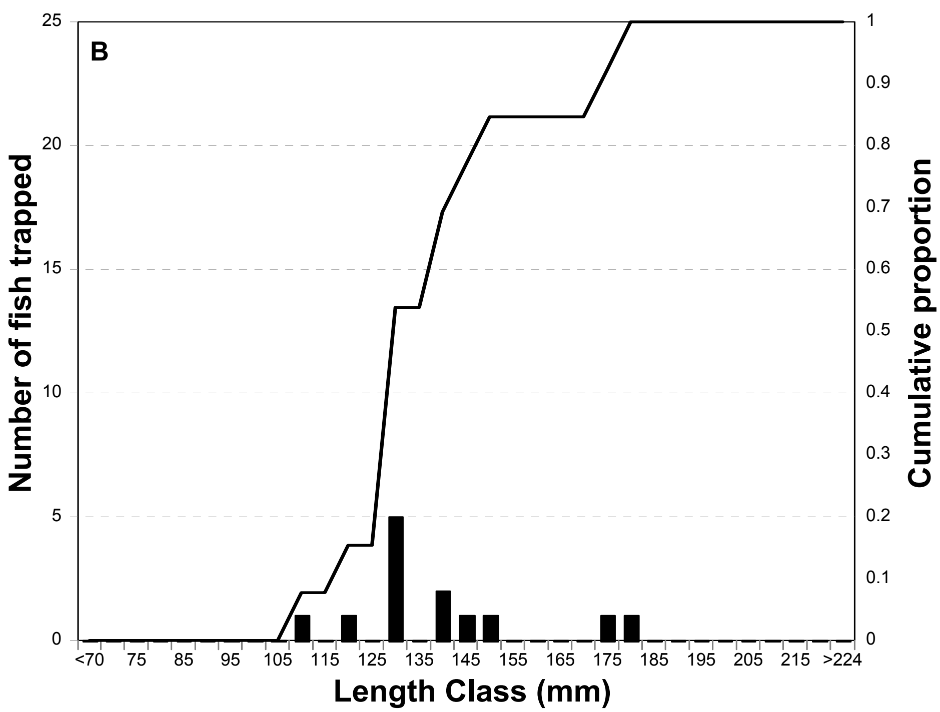


Figure 19. The length frequency of steelhead (bars) and the cumulative distribution (line) of length of those that were PIT tagged at the Pahsimeroi River in 1995. (A) Spring trapping season. (B) Fall trapping season.

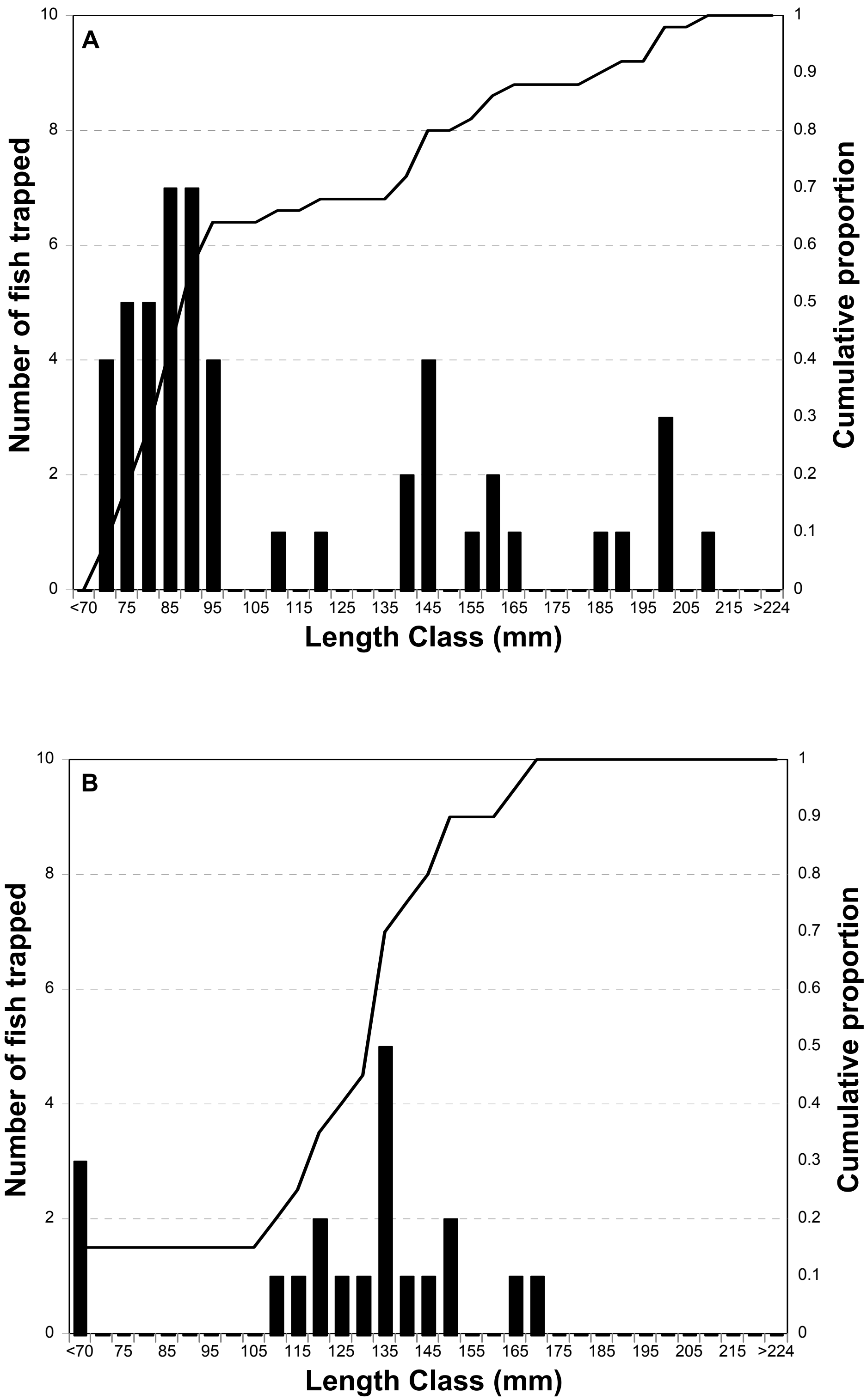


Figure 20. The length frequency of steelhead (bars) and the cumulative distribution (line) of length of those that were PIT tagged at the East Fork Salmon River in 1995. (A) Spring trapping season. (B) Fall trapping season.

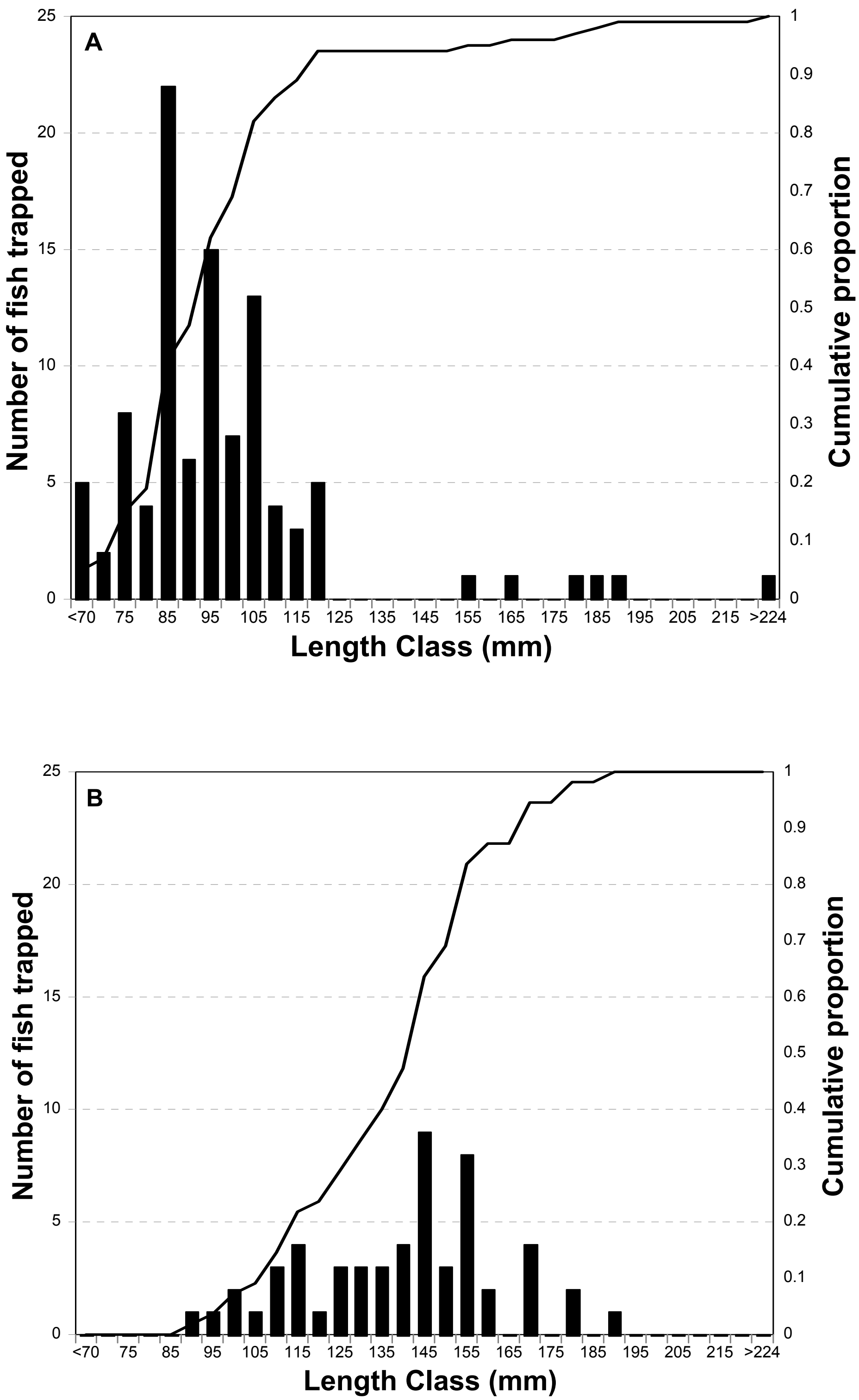


Figure 21. The length frequency of steelhead (bars) and the cumulative distribution (line) of length of those that were PIT tagged at the South Fork Salmon River in 1995. (A) Spring trapping season. (B) Fall trapping season.

Table 11. Matrix of pairwise probabilities obtained from Tukey's HSD multiple comparisons of fork length between streams for the spring and fall trapping periods in 1995.

Stream	Crooked Fork Creek	Fish Creek	Marsh Creek	Pahsimeroi River	East Fork Salmon River
Spring Tagged					
Crooked Fork Creek	--				
Fish Creek	<0.001	--			
Marsh Creek	<0.001	<0.001	--		
Pahsimeroi River	<0.001	0.001	<0.001	--	
East Fork Salmon River	<0.001	<0.001	0.228	<0.001	--
South Fork Salmon River	<0.001	<0.001	0.971	<0.001	0.066
Fall Tagged					
Cooked Fork Creek	--				
Fish Creek	<0.001	--			
Marsh Creek	0.201	1.000	--		
Pahsimeroi River	0.017	0.783	0.994	--	
East Fork Salmon River	<0.001	<0.001	0.002	0.116	--
South Fork Salmon River	<0.001	0.178	0.888	1.000	0.005

Table 12. Matrix of pairwise probabilities obtained from Tukey's HSD multiple comparisons of condition factor between streams for the spring and fall trapping periods in 1995.

Stream	Crooked Fork Creek	Fish Creek	Marsh Creek	Pahsimeroi River	East Fork Salmon River
Spring Tagged					
Crooked Fork Creek	--				
Fish Creek	<0.001	--			
Marsh Creek	<0.001	<0.001	--		
Pahsimeroi River	<0.001	0.552	0.044	--	
East Fork Salmon River	<0.001	0.584	0.748	0.989	--
South Fork Salmon River	<0.001	<0.001	<0.001	<0.001	<0.001
Fall Tagged [a]					
Cooked Fork Creek	--				
Fish Creek	0.001	--			
Marsh Creek					
Pahsimeroi River	<0.001	<0.001	--		
East Fork Salmon River	1.000	0.725	<0.001	--	
South Fork Salmon River	0.999	0.706	<0.001	1.000	--

[a] Weights were not measured at the Marsh Creek trap in the fall of 1995.

Table 13. The date that 10%, 25%, 50%, 75%, and 90% of the total number of steelhead juveniles were captured at the screw traps during the spring and fall trapping periods in 1995.

Site	Dates	Number Collected	Date Quantile Attained				
			10%	25%	50%	75%	90%
Spring screw traps							
Crooked Fork Creek	3/24-6/8	186	4/08	4/22	4/26	4/30	5/12
Fish Creek [a]	3/15-6/14	473	4/24	5/29	6/08	6/11	6/12
East Fork Salmon River	3/7-5/31	50	3/12	4/06	5/07	5/17	5/19
Marsh Creek	3/24-6/8	138	4/08	4/15	4/24	5/04	5/27
Pahsimeroi River	3/15-6/16	309	4/20	5/12	5/18	5/25	5/30
South Fork Salmon River	3/24-6/8	101	4/24	5/04	5/13	5/20	5/28
Fall screw traps							
Crooked Fork Creek	8/24-11/4	686	9/08	9/20	10/04	10/04	10/17
Fish Creek [b]	8/17-11/2	568	8/19	8/31	9/17	9/29	10/02
East Fork Salmon River	8/16-11/16	20	8/17	8/23	9/03	10/07	10/08
Marsh Creek	8/24-11/4	60	8/31	9/04	9/30	10/11	10/27
Pahsimeroi River	9/20-12/5	13	10/19	10/23	10/27	11/06	11/22
South Fork Salmon River	8/24-11/4	55	8/30	9/09	9/21	10/06	10/16

[a] The trap was pulled to shore for repairs from 5/18 to 5/22.
[b] The trap was not fished from 8/24 to 8/27.

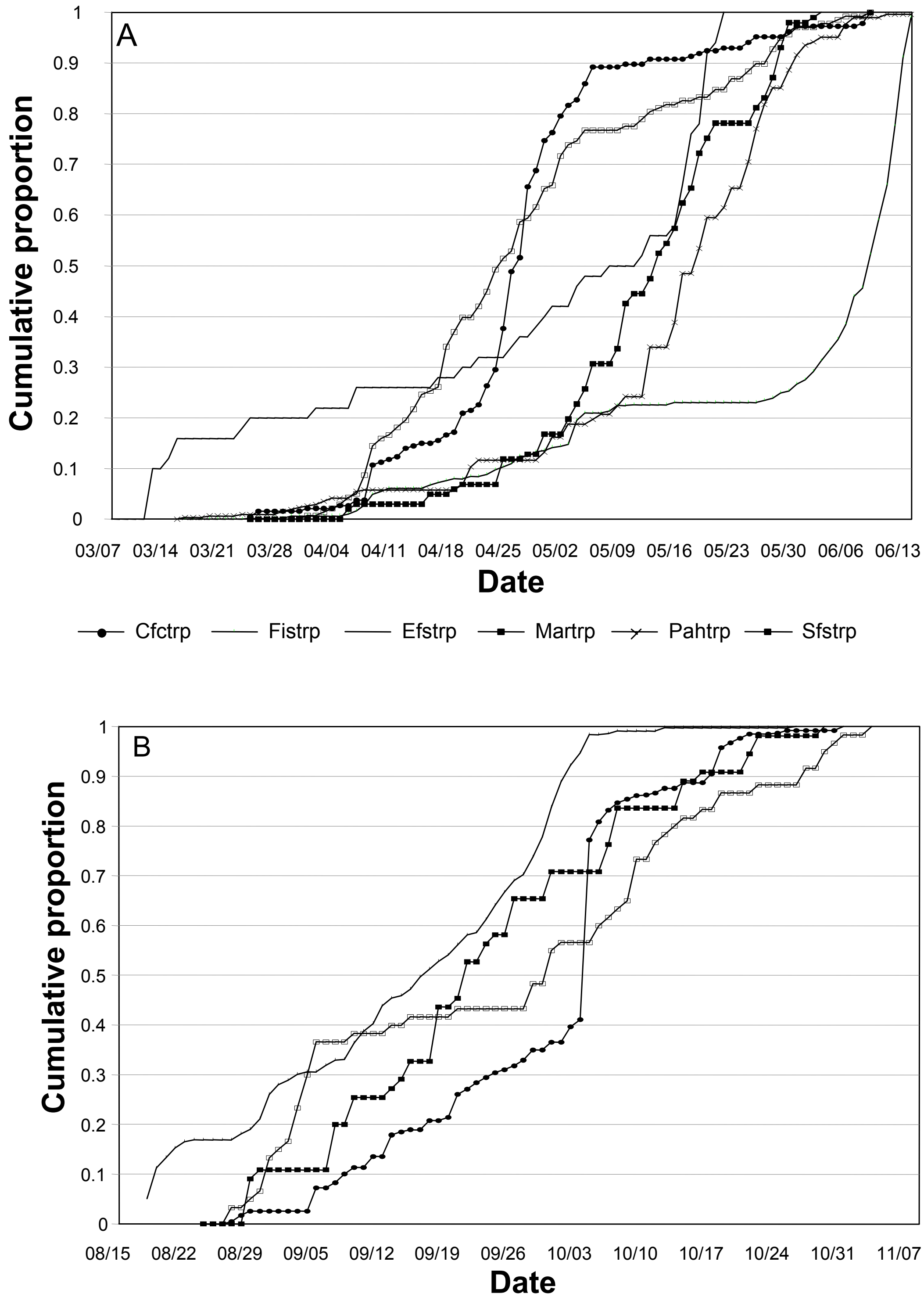


Figure 22. The cumulative distribution of the number of steelhead that were captured in screw traps in 1995. (A) Spring trapping season. (B) Fall trapping season. Cfctrp = Crooked Fork Creek, Fistrp = Fish Creek, Efstrp = East Fork Salmon River, Martrp = Marsh Creek, Pahtrp = Pahsimeroi River, and Sfstrp = South Fork Salmon River.

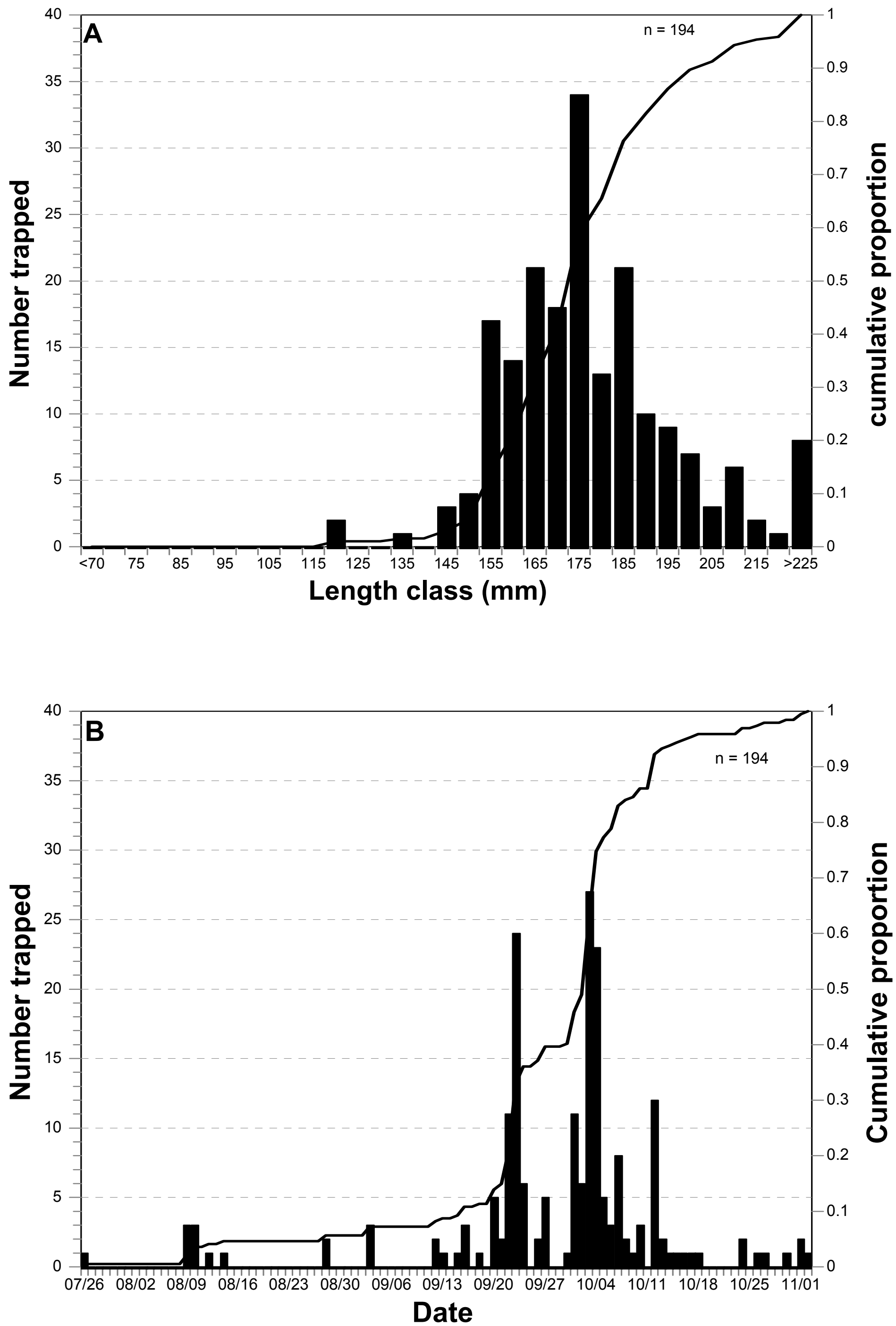


Figure 23. The number and length frequency of juvenile steelhead trapped in Rapid River from July 26 to November 2, 1995. (A) The length frequency of PIT-tagged steelhead (bars) and the cumulative distribution of length (line). (B) The daily number of steelhead trapped.

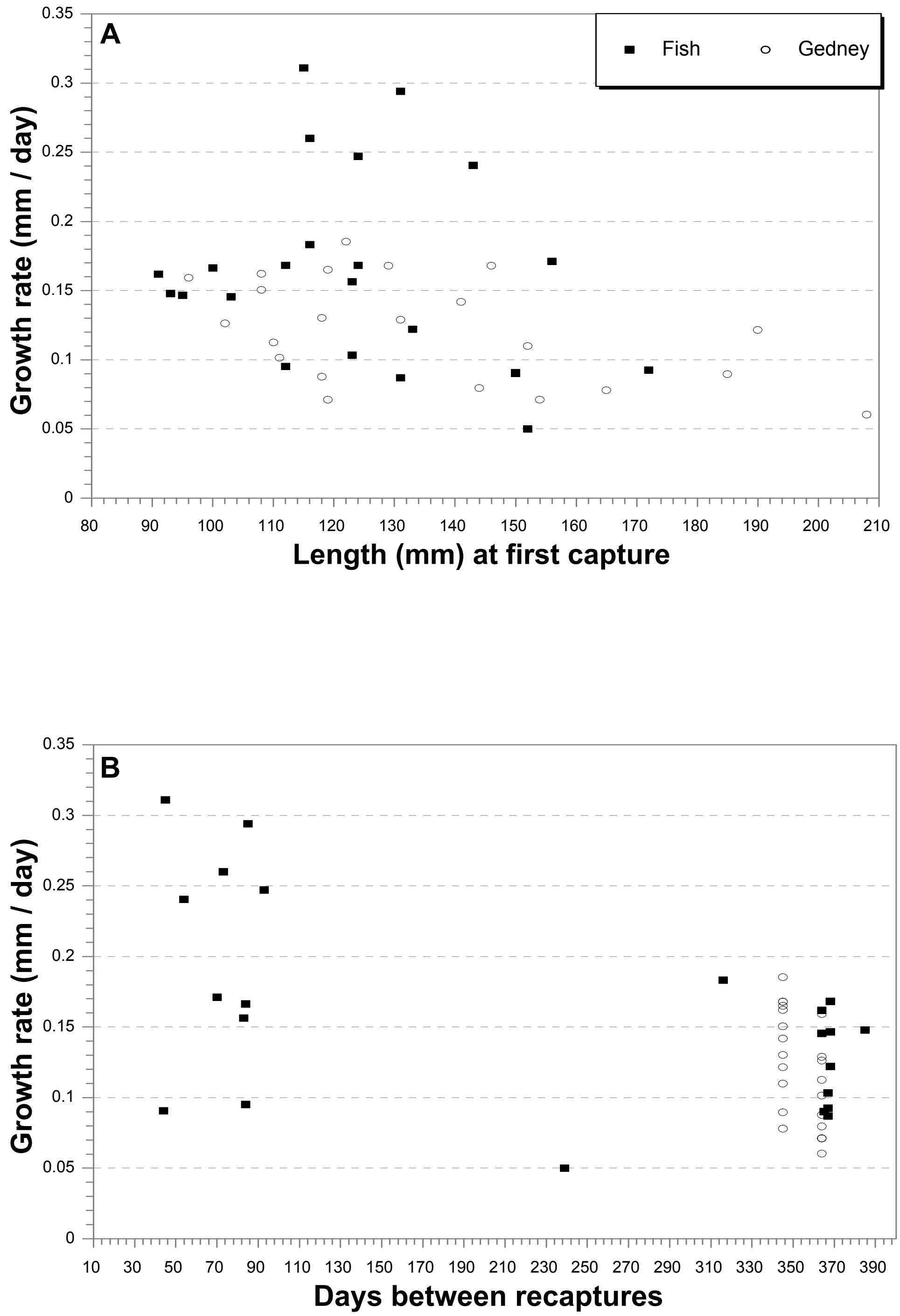


Figure 24. Growth rate (mm/day) of juvenile steelhead that were recaptured in Fish and Gedney creeks in 1995. (A) Relationship between growth rate and length at first capture. (B) Relationship between growth rate and time between recaptures.

Smolt Detections and Travel Time to Lower Granite Dam

We detected 1,296 steelhead smolts (Table 14, Figure 25) at all Snake and Columbia river dams. We detected 199 smolts that were tagged in the spring of 1995, 777 smolts tagged in the fall of 1994, 235 smolts tagged in 1994 before August 15, and 85 smolts tagged in 1993 (Table 14). Within each stream, the length of smolts that were tagged in 1993 or 1994 before August 15 was less than fish tagged in fall 1994 or spring 1995 (Table 15). The mean length of the fall 1994-tagged and spring 1995-tagged fish was 154 mm (95% CI ±2 mm) and 175 mm (95% CI ±3 mm), respectively. There was a significant difference in length, at the time of tagging, between these two groups (t-test, df = 968, $p<0.001$).

The median arrival date at LGR of the fall 1994- and spring 1995-tagged fish was May 8 and May 6, respectively. The Smirnov test revealed that there was no significant difference ($\alpha=0.05$) between the distribution function of arrival date at LGR of fish tagged in the fall and spring (Figure 26). This implies that the migration pattern past LGR of the fish tagged in fall 1994 was similar to that of fish tagged during spring 1995. The median arrival date at LGR of all smolts regardless of tagging date (n=741) was May 7. Seventy percent of the smolts were detected at LGR between May 1 and May 15, and 90% of all fish were detected by May 15 (Table 16).

Smolts from all streams had a similar arrival distribution at LGR (Figure 27). The earliest median smolt arrival date was May 2 from Rapid River and the latest, May 14, was from the Pahsimeroi River. The median arrival date of smolts for the other streams was between May 5 and May 10 (Table 16, Figure 27).

We had 102 detections at LGR from smolts that were tagged in spring 1995. We detected 56 smolts from Crooked Fork Creek, 29 from Fish Creek, 13 from the Pahsimeroi River, and four from other streams. The median travel time was 41.4 km/day (confidence 90%; $36.1<41.4<44.2$ km/day) when the data from all sites was combined. The median travel time in Crooked Fork Creek was 42.6 km/day (confidence 90%; $26.1<42.6<54$ km/day); 28.8 km/day in Fish Creek (confidence 90%; $23.5<28.8<39$ km/day); and 85.9 km/day (confidence ≥90%; $73.3<85.9<118.1$ km/day) in the Pahsimeroi River (Figure 28).

There was no correlation (r=0.122, n=102, p=0.221) between the length of the smolt and its travel time (Figure 29a). There was a significant positive correlation between release date and travel time (r=0.456, n=102, $p<0.001$). Smolt travel time to LGR increased throughout the month of April and peaked in mid-May. After May 15, the travel time declined for most smolts (Figure 29b).

Adult and Juvenile Scale Samples

We collected scales from 44 adults in Clear Creek and 32 adults in Fish Creek. We collected juvenile scales from 45 parr in the South Fork Salmon River and 105 parr from Fish Creek. All scales were archived at the Nampa Research Center for future aging.

Table 14. The number of wild steelhead smolts that were detected in 1995 at Lower Granite, Little Goose, Lower Monumental, McNary, John Day, and Bonneville dams and the number of steelhead juveniles <140 mm and ≥140 mm fork length that were PIT tagged. Tagging periods were defined as: 1994 from March 3 to August 14, 1994; Fall 94 from August 15 to December 8, 1994; Spring 95 from March 12 to May 15, 1995; and 1993 all dates that year. NT = none tagged.

		Fall 1994 Tagged		Spring 1995 Tagged		Number of detections of fish tagged in			
Site	**Number Detected**	**<140 mm**	**≥140 mm**	**<140 mm**	**≥140 mm**	**1993**	**1994**	**Fall 94**	**Spring 95**
Crooked Fork Creek	154	99	18	4	154	14	21	10	109
Fish Creek	704	1,606	682	17	84	12	148	496	48
East Fork Salmon River	8	22	6	17	12	0	2	0	6
Gedney Creek	116	215	164	0	0	NT	43	73	NT
Marsh Creek	31	145	20	92	9	15	0	12	4
Pahsimeroi River	45	105	30	16	62	0	3	13	29
Rapid River	148	14	360	0	0	0	2	146	NT
Red River	18	22	11	0	0	7	5	6	NT
South Fork Salmon River	63	76	69	53	5	37	4	19	3
Whitecap Creek	9	15	13	0	0	NT	7	2	NT
Totals	**1,296**	**2,304**	**1,360**	**199**	**326**	**85**	**235**	**777**	**199**

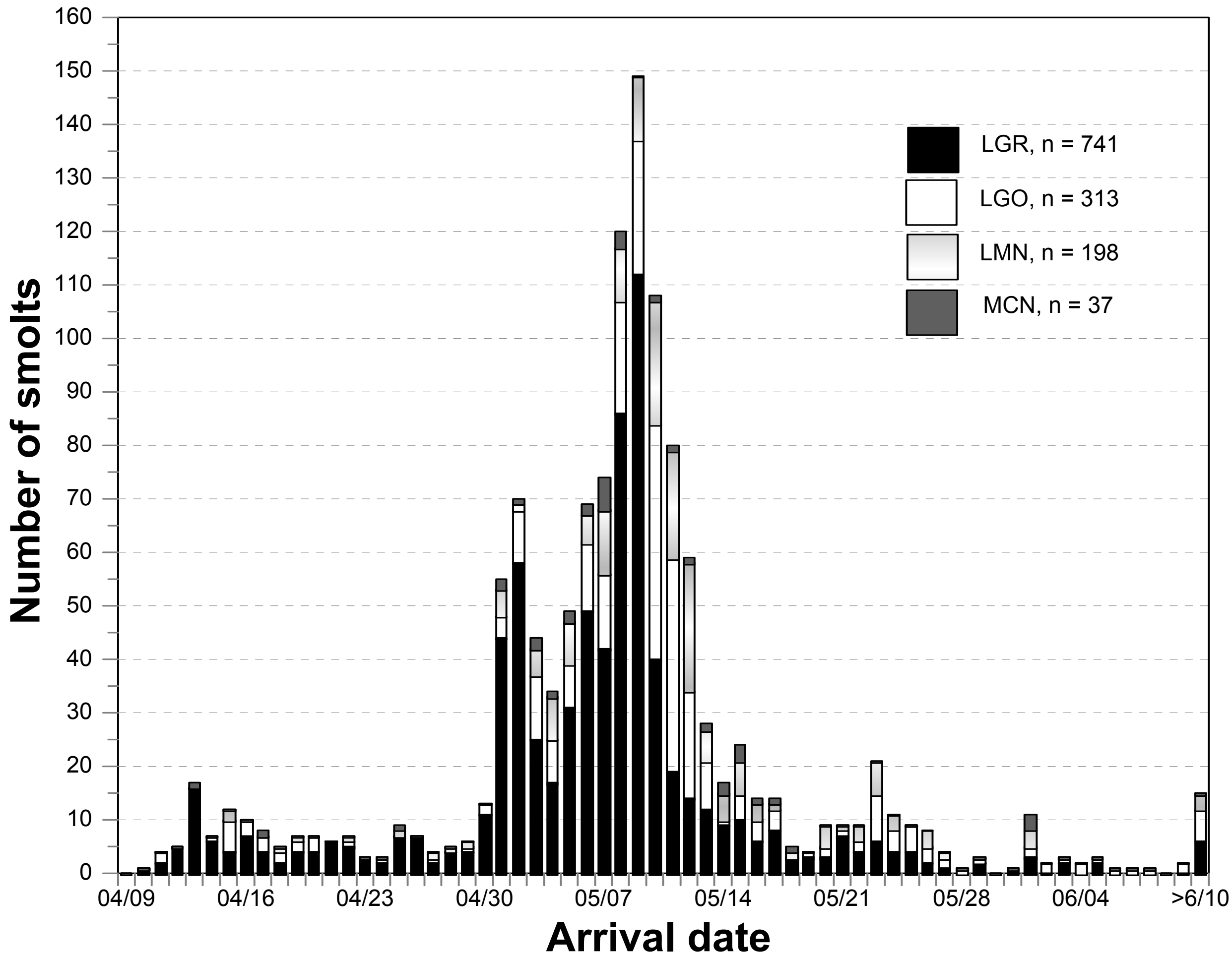


Figure 25. The arrival date in 1995 of steelhead smolts at Lower Granite (LGR), Little Goose (LGO), Lower Monumental (LMN), and McNary dams. If a smolt was detected at more than one dam, only the site and date of the first detection was plotted. Seven smolts that were detected at other dams were not included in this graph.

Table 15. Length (mm) and condition factor (K) statistics, at the time of tagging, of steelhead smolts detected at all dams in 1995. The standard deviation of the mean is in parentheses.

Stream	Mean		Median		Number	
	Length	K	Length	K	Length	K
1993 tagged						
Crooked Fork Creek	123 (31)	1.0446 (0.0856)	134	1.0183	14	6
Fish Creek	116 (8)	1.0440 (0.2330)	112	0.9671	12	12
Red River	111 (22)	0.9659 (0.1025)	114	0.9694	7	5
Marsh Creek	130 (14)	0.9851 (0.0738)	128	0.9997	15	12
South Fork Salmon River	122 (26)	1.0485 (0.1512)	116	1.0122	37	29
Spring 1994 tagged (3/7-6/20)						
Crooked Fork Creek	116 (19)	1.0717 (0.0961)	113	1.0898	21	21
Fish Creek	118 (13)	1.0884 (0.0799)	120	1.0938	64	64
Red River	104 (35)	1.2001 (0.1203)	104	1.2001	2	2
East Fork Salmon River	116 (6)	0.9883 (0.1982)	116	0.9883	2	2
Marsh Creek	131 (19)	0.9246 (0.0754)	125	0.9246	3	2
Pahsimeroi River	146 (26)	0.9980 (0.0417)	154	1.0177	3	3
South Fork Salmon River	116 (9)	--	113	--	4	0
Summer 1994 tagged (6/21-8/14)						
Fish Creek	151 (15)	1.1350 (0.0738)	152	1.1289	84	84
Gedney Creek	143 (14)	0.9229 (0.0887)	153	0.9535	73	72
Red River	127 (6)	--	124	--	3	0
Whitecap Creek[a]	152 (27)	--	151	--	9	0
Fall 1994 tagged (8/15-12/7)						
Crooked Fork Creek	154 (33)	--	157	--	10	0
Fish Creek (fly-fishing)	155 (17)	0.8543 (0.0810)	154	0.8368	152	144
Fish Creek (screw trap)	144 (16)	0.9345 (0.0479)	143	0.9327	344	324
Gedney Creek (fly-fishing)	154 (17)	0.9229 (0.0887)	153	0.9535	73	72
Red River	158 (28)	1.0184 (0.0369)	145	1.0212	6	6
Marsh Creek	158 (5)	0.9446 (0.0501)	160	0.9412	8	8
Pahsimeroi River	128 (19)	0.9681 (0.0593)	125	0.9841	13	13
Rapid River	182 (16)	0.9795 (0.1003)	181	0.9905	146	142
South Fork Salmon River	161 (13)	1.0720 (0.0919)	158	1.0804	18	13
Spring 1995 tagged (3/2-6/15)						
Crooked Fork Creek	181 (16)	0.8657 (0.0620)	183	0.8595	109	103
Fish Creek	165 (17)	0.9276 (0.0921)	166	0.9046	48	48
Red River	104 (33)	--	104	--	2	0
East Fork Salmon River	182 (27)	0.9627 (0.0525)	184	0.9507	6	6
Marsh Creek	151 (2)	0.9893 (0.0416)	150	0.9890	4	4
Pahsimeroi River	171 (17)	0.9556 (0.0547)	170	0.9566	29	28
South Fork Salmon River	144 (51)	1.0263 (0.1436)	166	1.0384	3	3

[a] Fish were collected and tagged on three days: July 26, July 27, and August 30.

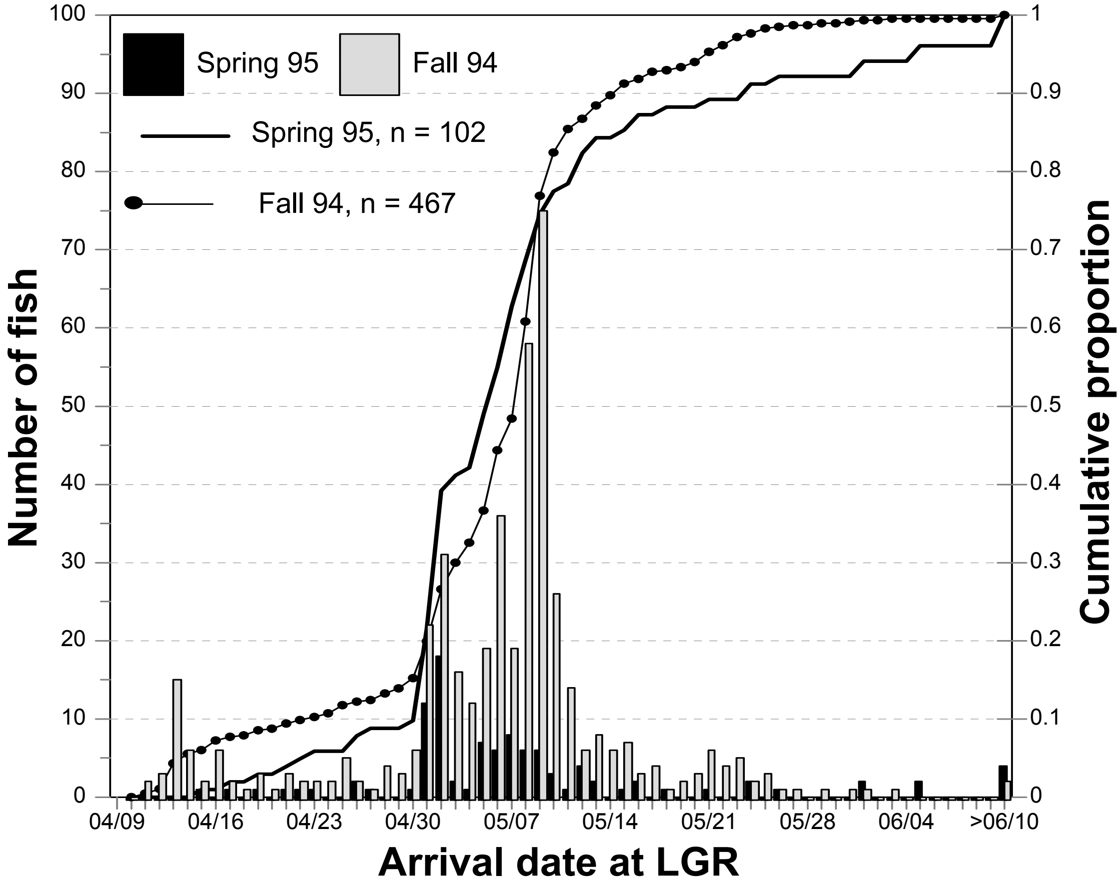


Figure 26. The arrival date in 1995 at Lower Granite Dam of smolts (bars) that were tagged in the spring of 1995 (March 2 to June 15) and the fall of 1994 (August 15 to December 7) and the cumulative proportion of the total number of detections (lines).

Table 16. The date that 10%, 25%, 50%, 75%, and 90% of the total number of smolts were detected at Lower Granite Dam in 1995. The data includes all smolts that were detected in the spring 1995 regardless of the tagging date.

		Date Quantile Attained				
Stream	**Number Detected**	**10%**	**25%**	**50%**	**75%**	**90%**
Crooked Fork Creek	78	4/30	5/2	5/5	5/8	5/9
Fish Creek	399	5/1	5/5	5/8	5/9	5/14
Gedney Creek	65	5/1	5/3	5/6	5/9	5/14
Marsh Creek	19	4/24	5/3	5/10	5/16	6/3
Pahsimeroi River	21	5/9	5/11	5/14	5/18	5/23
Rapid River	100	4/13	4/18	5/2	5/9	5/10
South Fork Salmon River	45	4/13	4/25	5/5	5/10	5/17
All sites combined	**741**	**4/25**	**5/2**	**5/7**	**5/9**	**5/15**

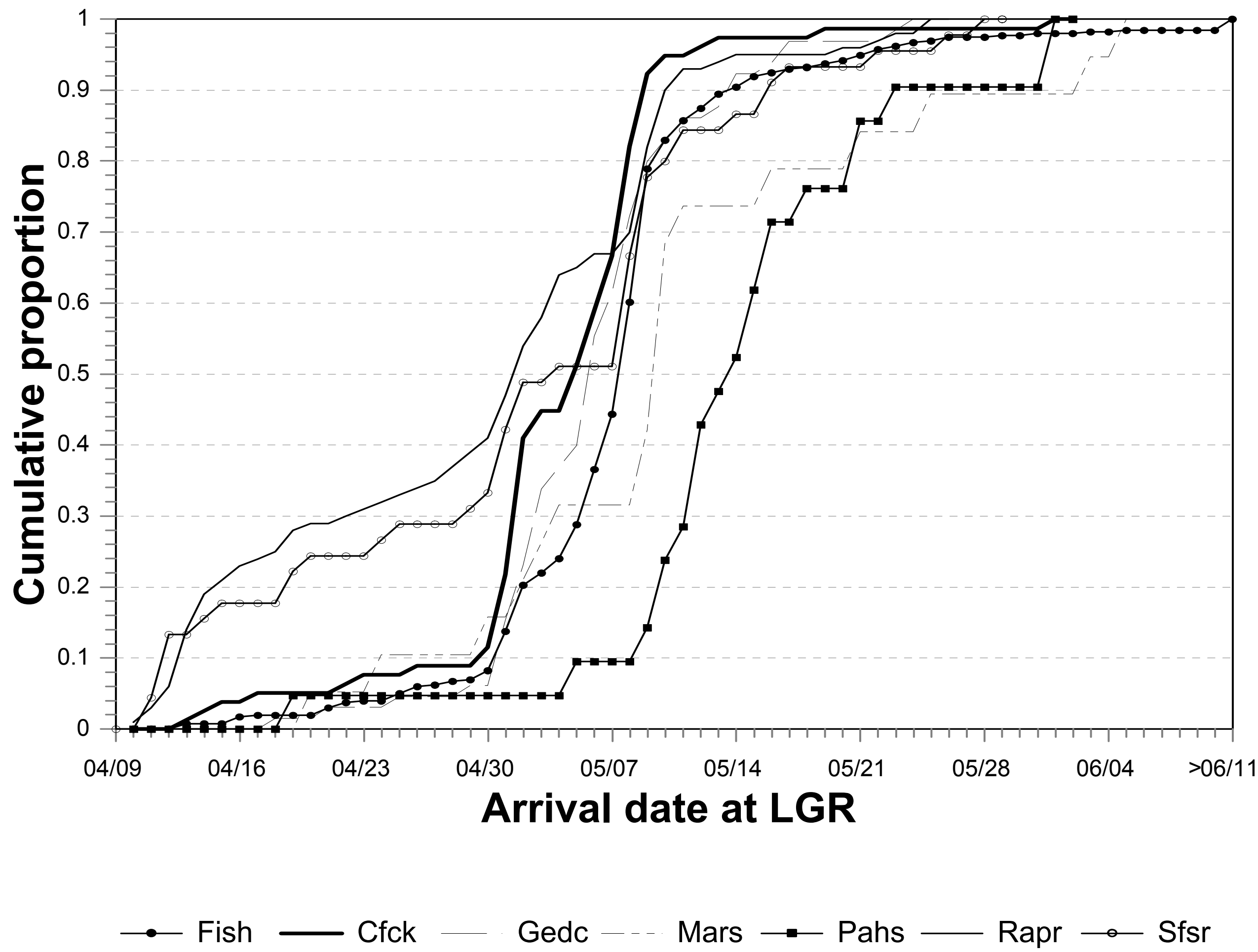


Figure 27. The cumulative proportion of the total number of smolts detected, regardless of the tagging date, at Lower Granite Dam (LGR) in 1995. Cfck = Crooked Fork Creek, Fish = Fish Creek, Gedc = Gedney Creek, Mars = Marsh Creek, Pahs = Pahsimeroi River, Rapr = Rapid River, and Sfstrp = South Fork Salmon River.

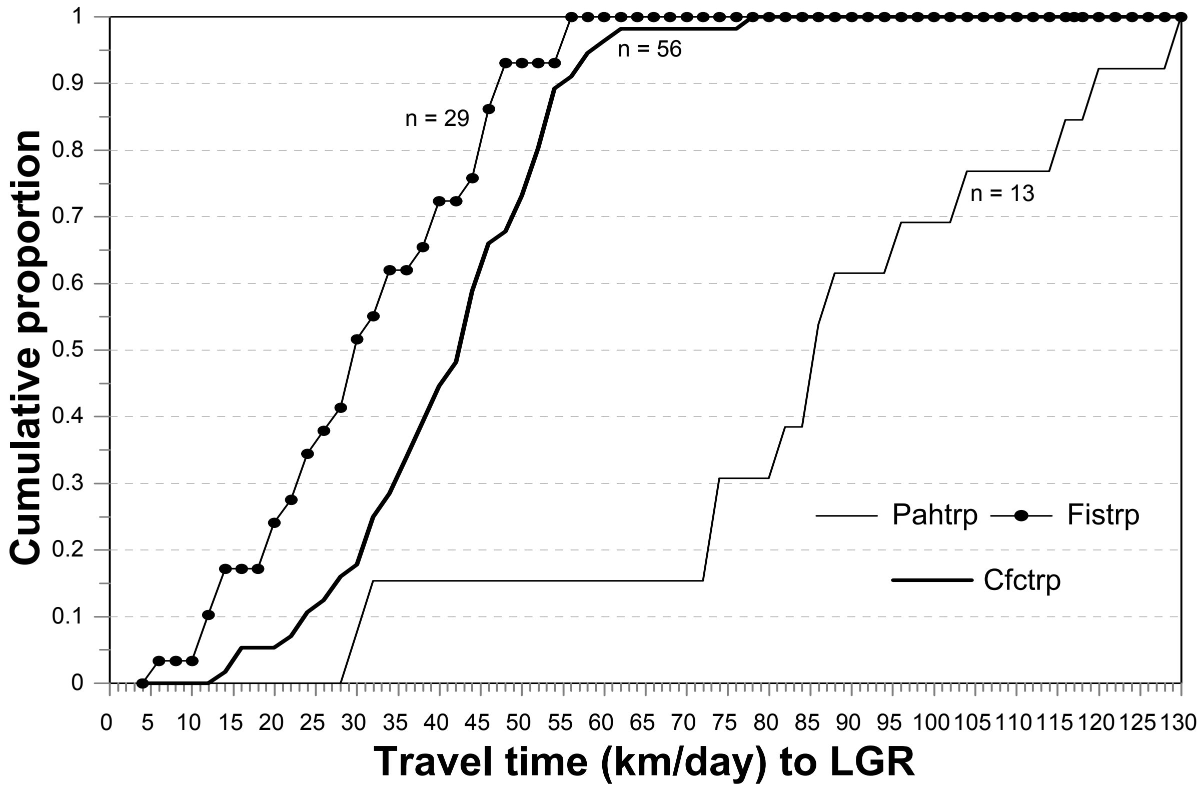
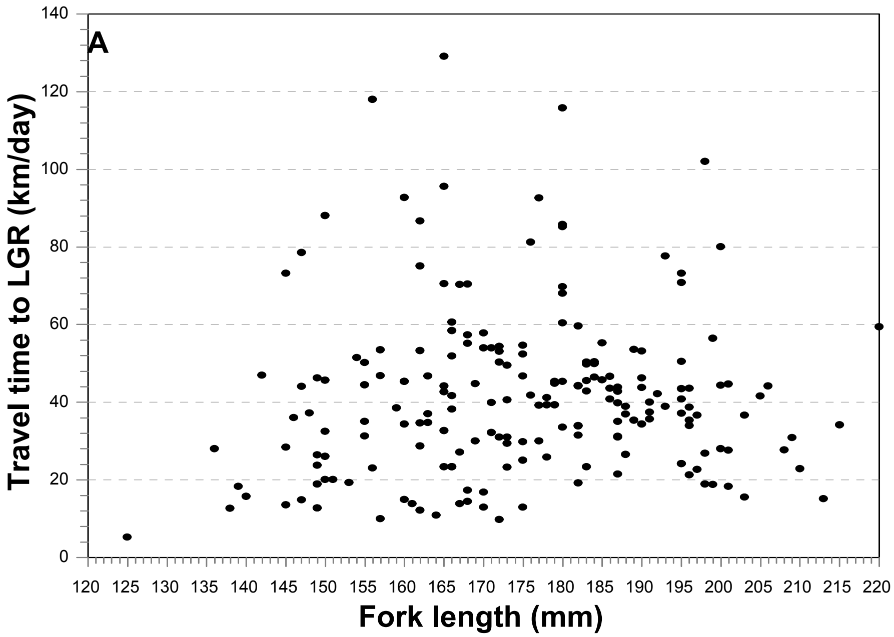


Figure 28. The cumulative proportion of travel time (km/day) to Lower Granite Dam (LGR) of smolts that were tagged in the spring of 1995. Cfctrp = Crooked Fork Creek, Fistrp = Fish Creek, and Pahtrp = Pahsimeroi River.



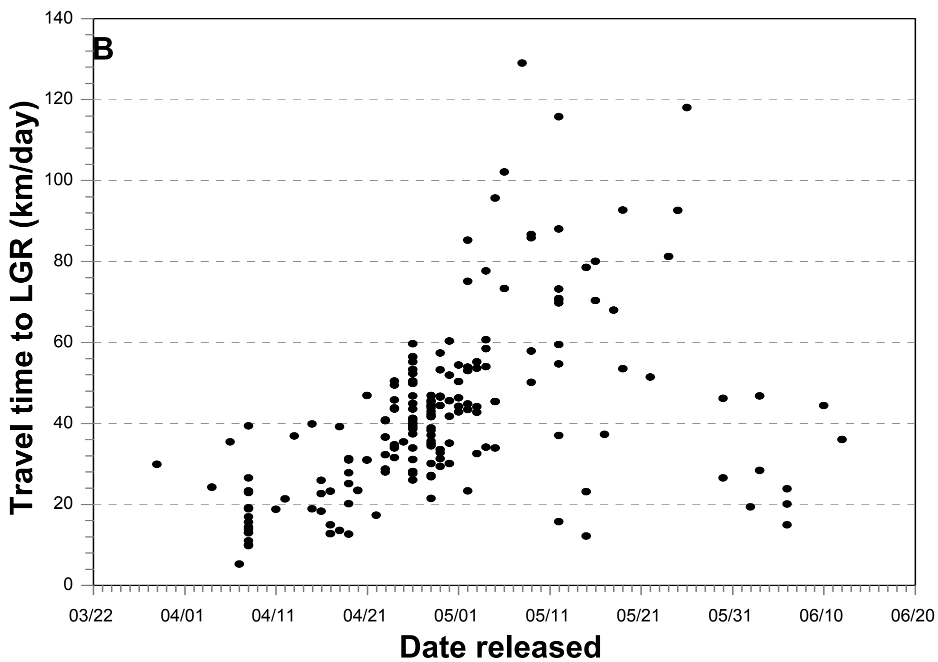


Figure 29. Travel time (km/day) of steelhead smolts detected at Lower Granite Dam (LGR) in 1995 that were tagged at all screw traps. (A) The relationship between length and travel time. (B) The relationship between tagging date (1995) at the screw trap and travel time.

DISCUSSION

We stocked hatchery adult steelhead from the Sawtooth Fish Hatchery in Beaver Creek for the third consecutive spring in 1995. The fry density in Beaver Creek this year was <1 fry/100 m^2, however, we snorkeled the stream prior to the predicted fry emergence date. We did not stock adults in Frenchman Creek this year as we had the past two years, but we counted some fry (0.94 fry/100 m^2) when we snorkeled it on August 4. These fry could be progeny of natural spawning or slow growing fish that emerged in 1994 since we classify any steelhead $\leq$75 mm as fry. The age-1 densities declined from nearly 11 fish/100 m^2 in 1994 to 4 fish/100 m^2 this year in Beaver Creek. The 1994 age-1 fish were produced from 15 females (5 redds counted) stocked in 1993, and the 1995 age-1 fish were produced from 8 females (6 redds counted) stocked in 1994. We counted redds daily or every other day in 1994 but only once a week in 1993. It is possible that we missed several redds in 1993 and that the large decline (about 74%) in age-1 density could be from fewer females spawning in 1994 than 1993. The age-1 densities declined about 24% in Frenchman Creek in 1995. The IDFG crews stocked 10 females in Frenchman Creek in 1993 and 1994; but we observed heavy otter predation on the adults in 1994.

In the South Fork Red River, age-1 steelhead densities declined 55% despite stocking 50,000 fingerlings on October 27, 1994. The fish were stocked late because of an outbreak of columnaris in early September. Idaho Department of Fish and Game hatchery personnel treated the fish with medicated feed, which postponed the stocking date. The water temperature in the stream dropped to 0°C on November 2 and remained near zero until the following spring. Because the fish were stocked late, they may not have had adequate time to acclimate and find suitable habitat to overwinter before the stream froze. This could explain the decline in survival compared with the fingerlings that were stocked in 1993.

In 1995, IDFG installed a temporary weir in Fish Creek to estimate wild adult steelhead escapement. The National Biological Survey used this weir in Fish Creek from 1992-1994. Fish Creek is a tributary to the Lochsa River and can serve as an indicator of the status of wild steelhead in that drainage. We passed 32 adult steelhead over the weir, the lowest number since 1992. Trap tenders documented that river otters killed four females and three males. The trap tenders think that one female and one male were spawned-out kelts. Because the otters were killing a high percentage of adults and the run was small, we pulled pickets so fish could pass the weir freely on May 2. More fish probably entered the stream to spawn after May 2. During the three previous years, the percentage of the total adult escapement that had passed the weir by May 2 was 69%, 41%, and 62%, respectively. Based on the previous three years' data, 14 to 46 adults could have entered Fish Creek after we opened the weir and would place the total escapement in the range of 46 to 78 fish. However, the adult run timing may have differed in 1995 because, in the previous three years, stream flow was less due to below-normal snow pack.

Age-1 juvenile steelhead densities declined in all streams this year compared with those observed in 1994. This decline was expected, as adult escapement into Idaho was less in 1994 than 1993. In Fish Creek, the number of females entering the stream dropped from 204 in 1993 to 37 in 1994, a decline of 82%. The resulting age-1 densities from these brood years declined 38%, from 16.65 fish/100 m^2 in 1994 to 10.03 fish/100 m^2 this year. The decline in fish densities was reflected in the number of juvenile steelhead that we collected in the screw trap. In Fish Creek, we trapped 1,041 fish in 1995, compared with 3,170 in 1994. This trend was similar in all streams that had screw traps—the number of fish trapped declined at each site this year. Because of the low number of fish tagged at each site, we only had enough detections at LGR to calculate travel time from Fish Creek, Crooked Fork Creek, and the Pahsimeroi River.

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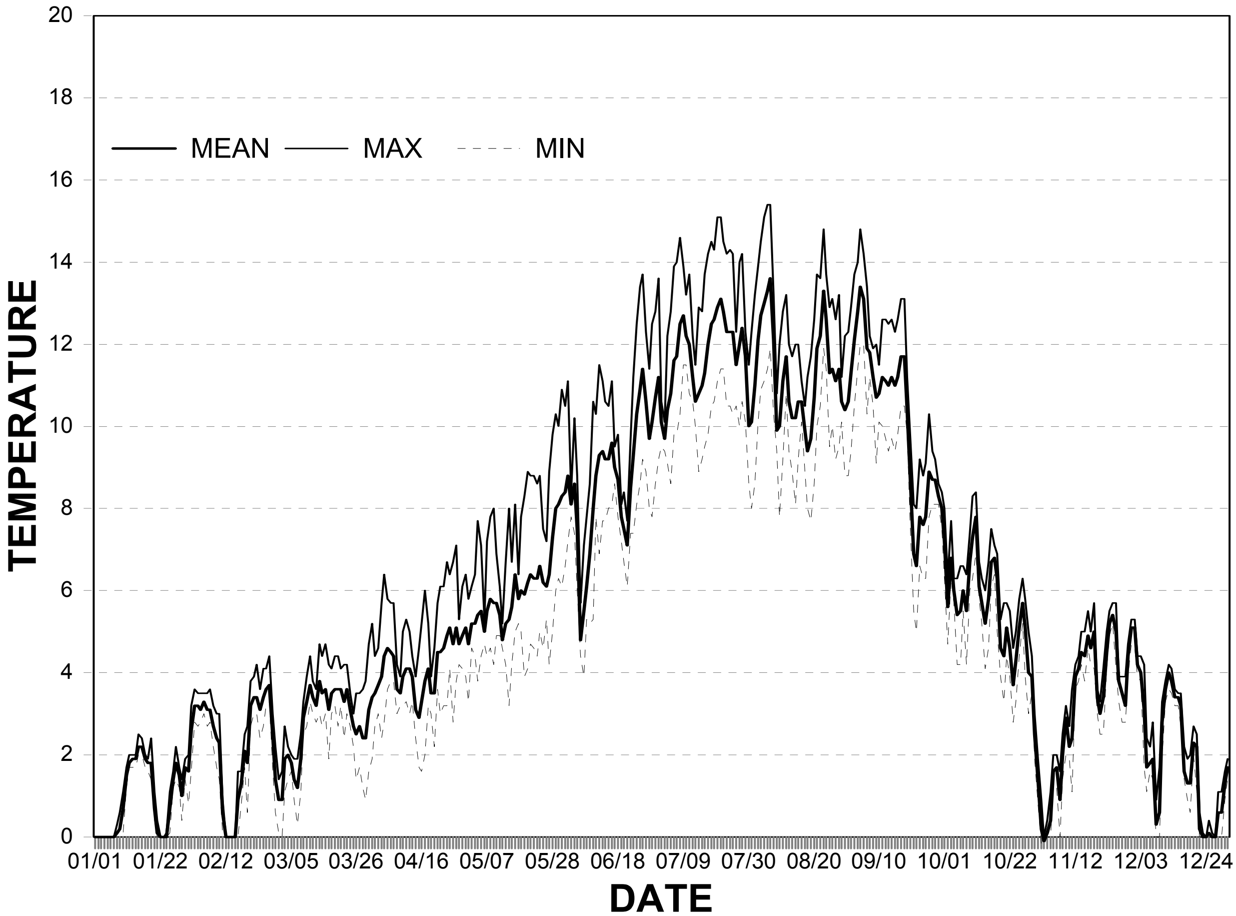
APPENDICES

Appendix 1. The daily mean, maximum, and minimum water temperature (°C) in Bald Mountain Creek from January 1, 1995 to December 31, 1995.



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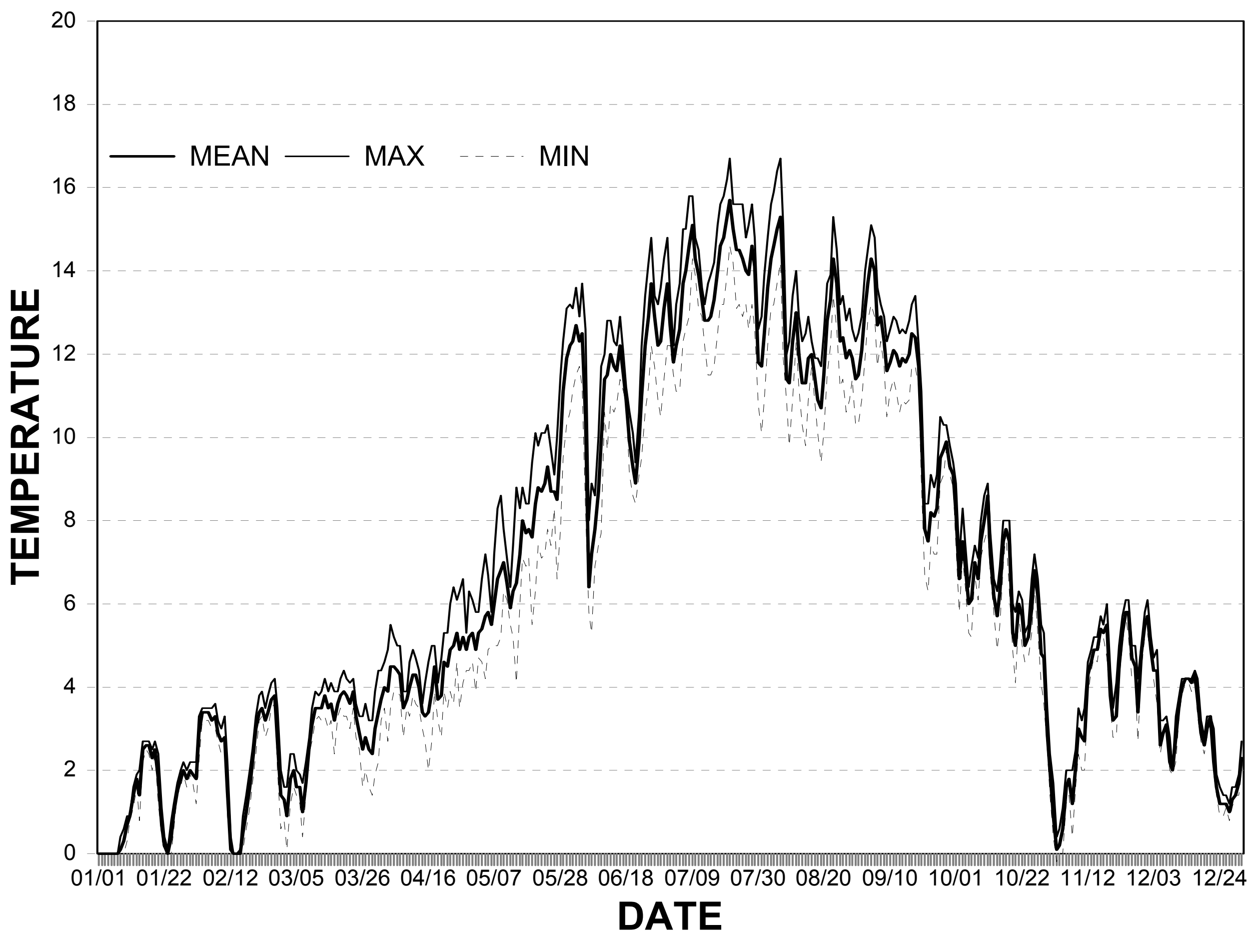
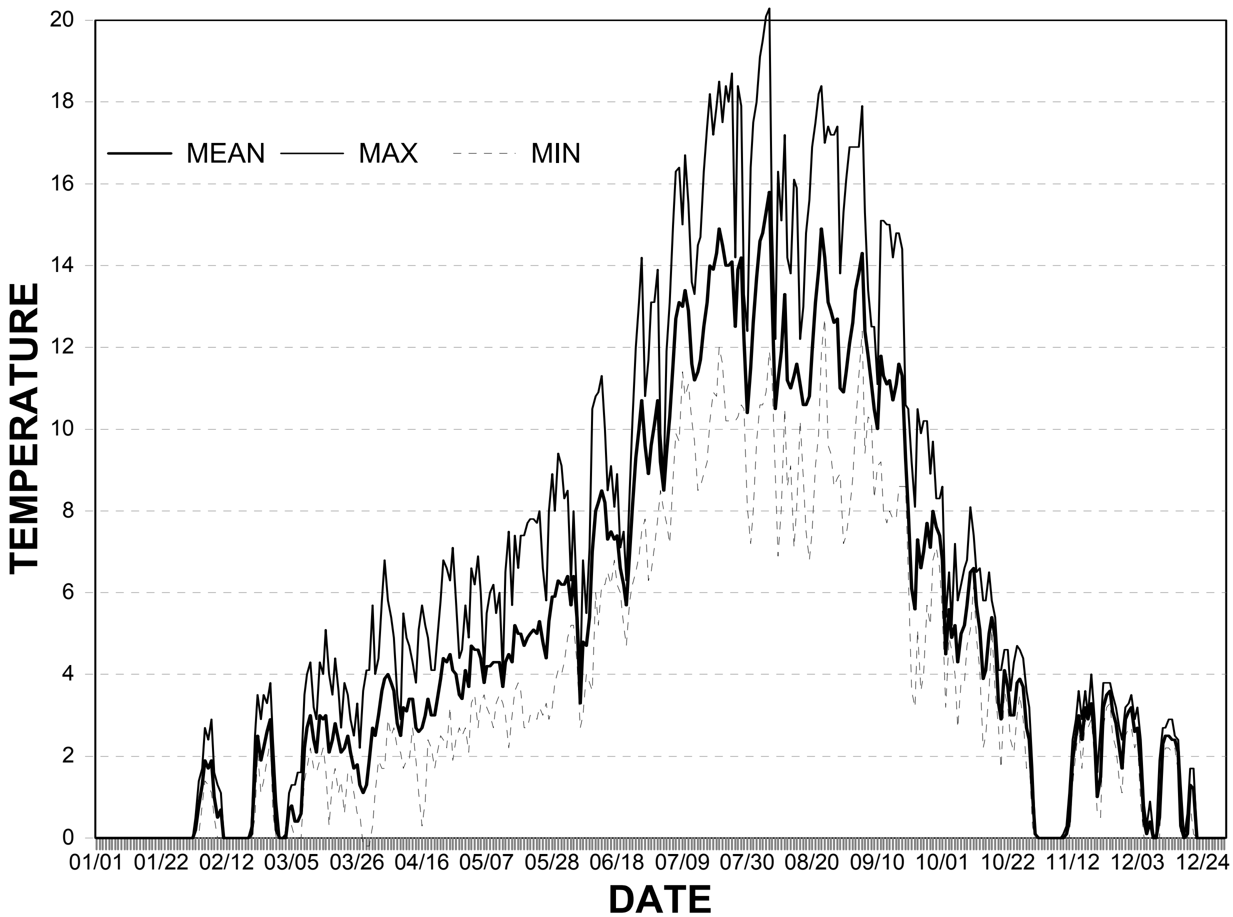
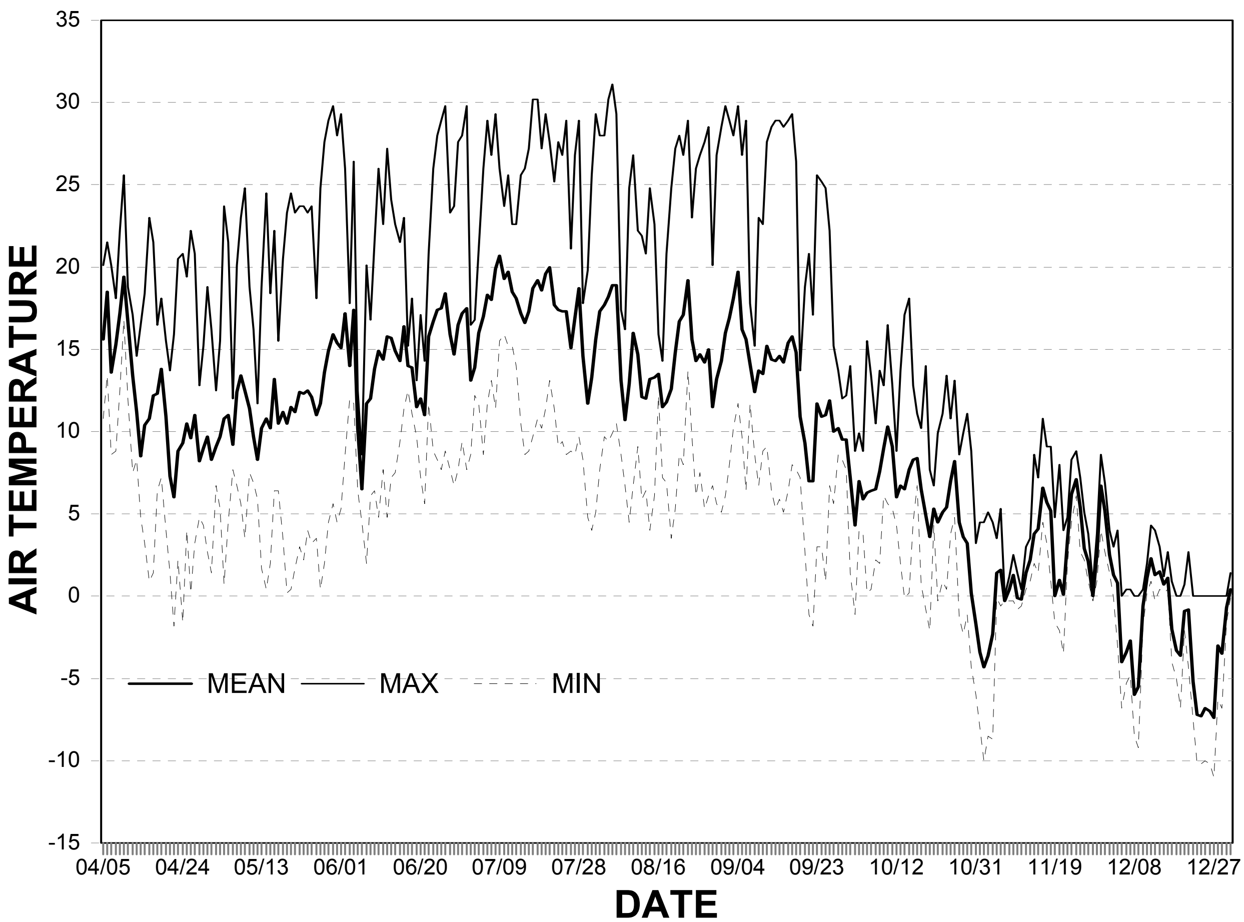
Appendix 2. The daily mean, maximum, and minimum water temperature (°C) in Canyon Creek from January 1, 1995 to December 31, 1995.



Appendix 3. The daily mean, maximum, and minimum water temperature (°C) in Crooked Fork Creek from January 1, 1995 to December 31, 1995.



Appendix 4. The daily mean, maximum, and minimum air temperature (°C) recorded at the Fish Creek trailhead from April 5, 1995 to December 31, 1995.



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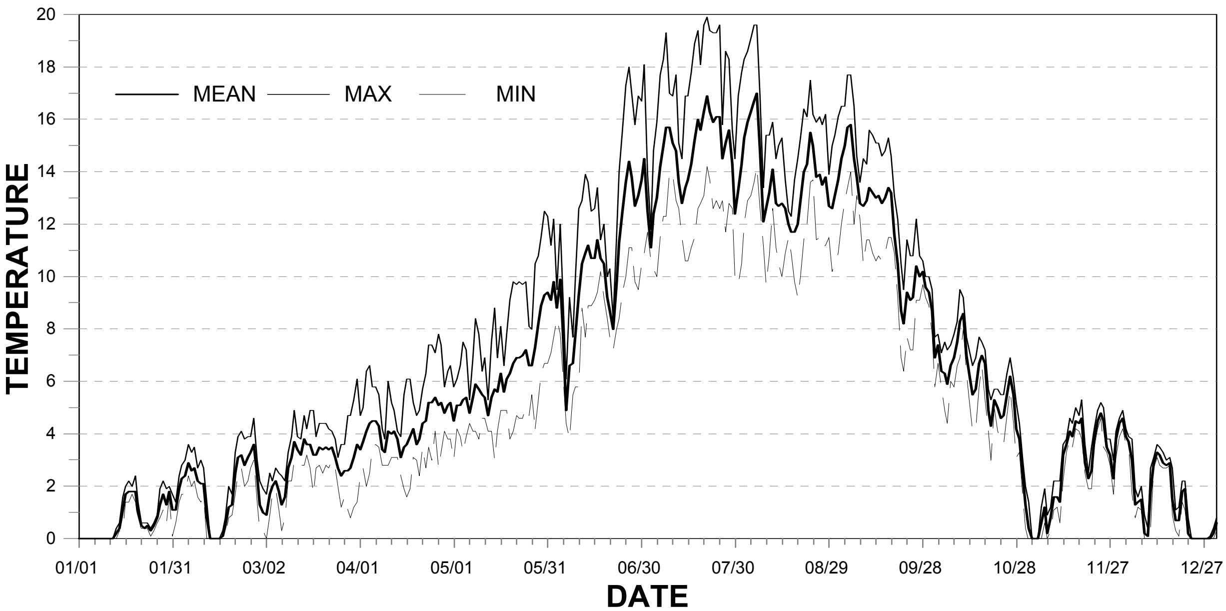
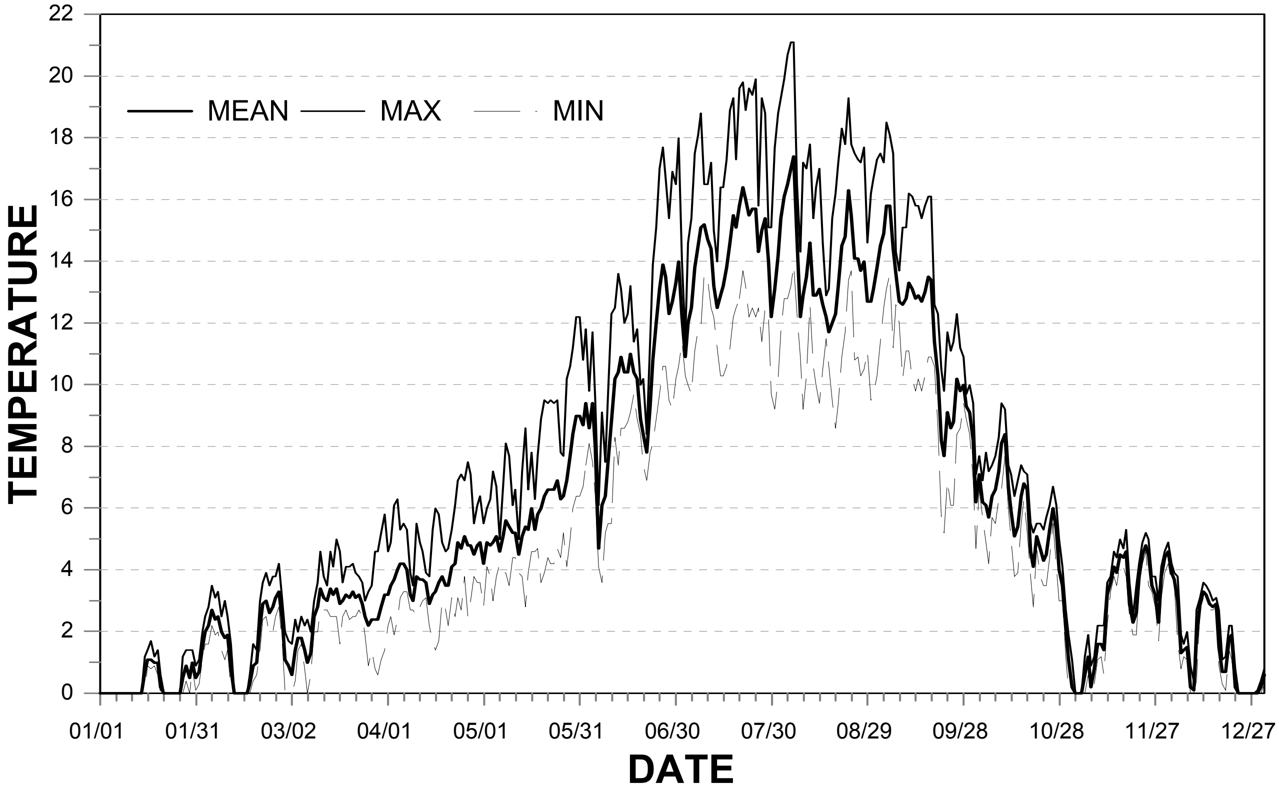
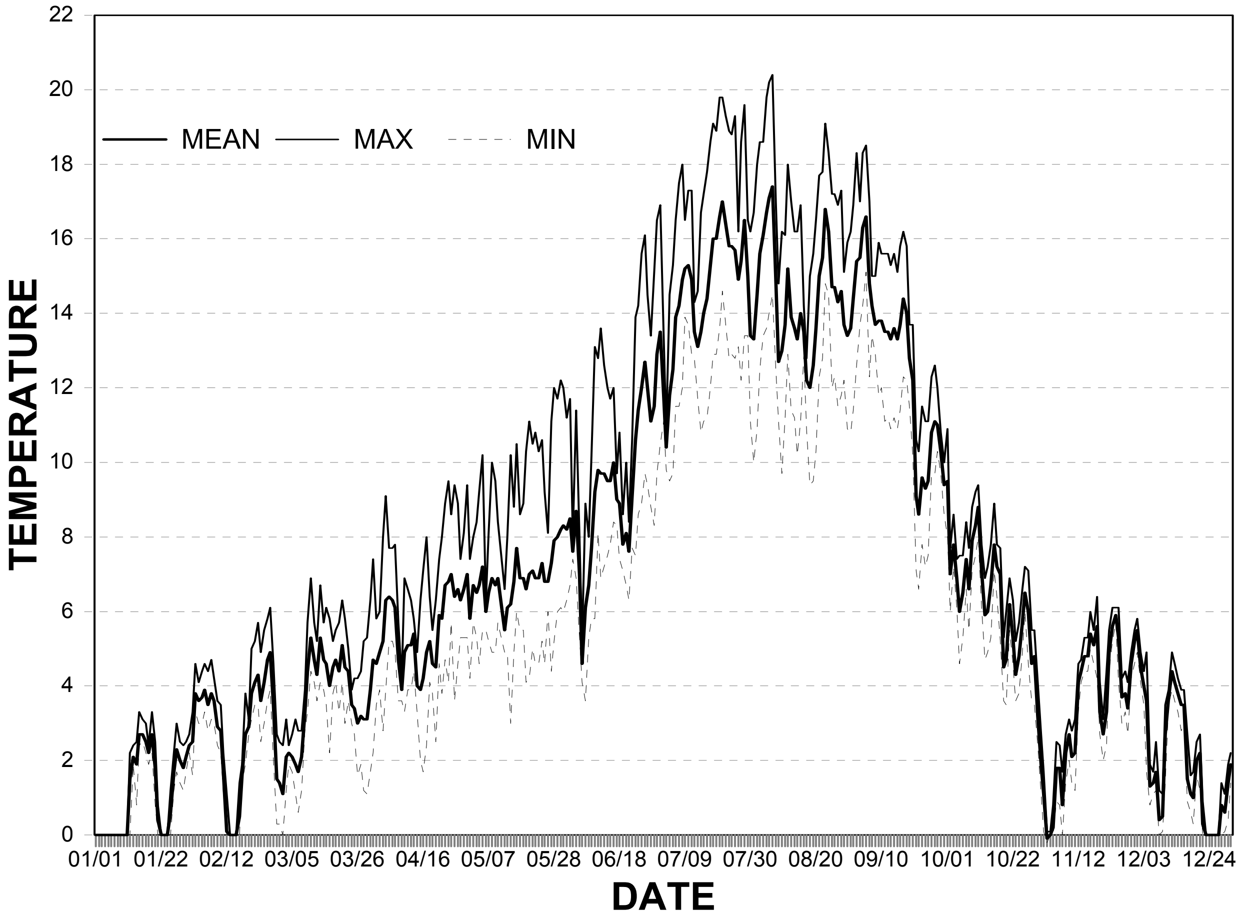
Appendix 5. The daily mean, maximum, and minimum water temperature (°C) in Fish Creek at the weir site from January 1, 1995 to December 31, 1995.



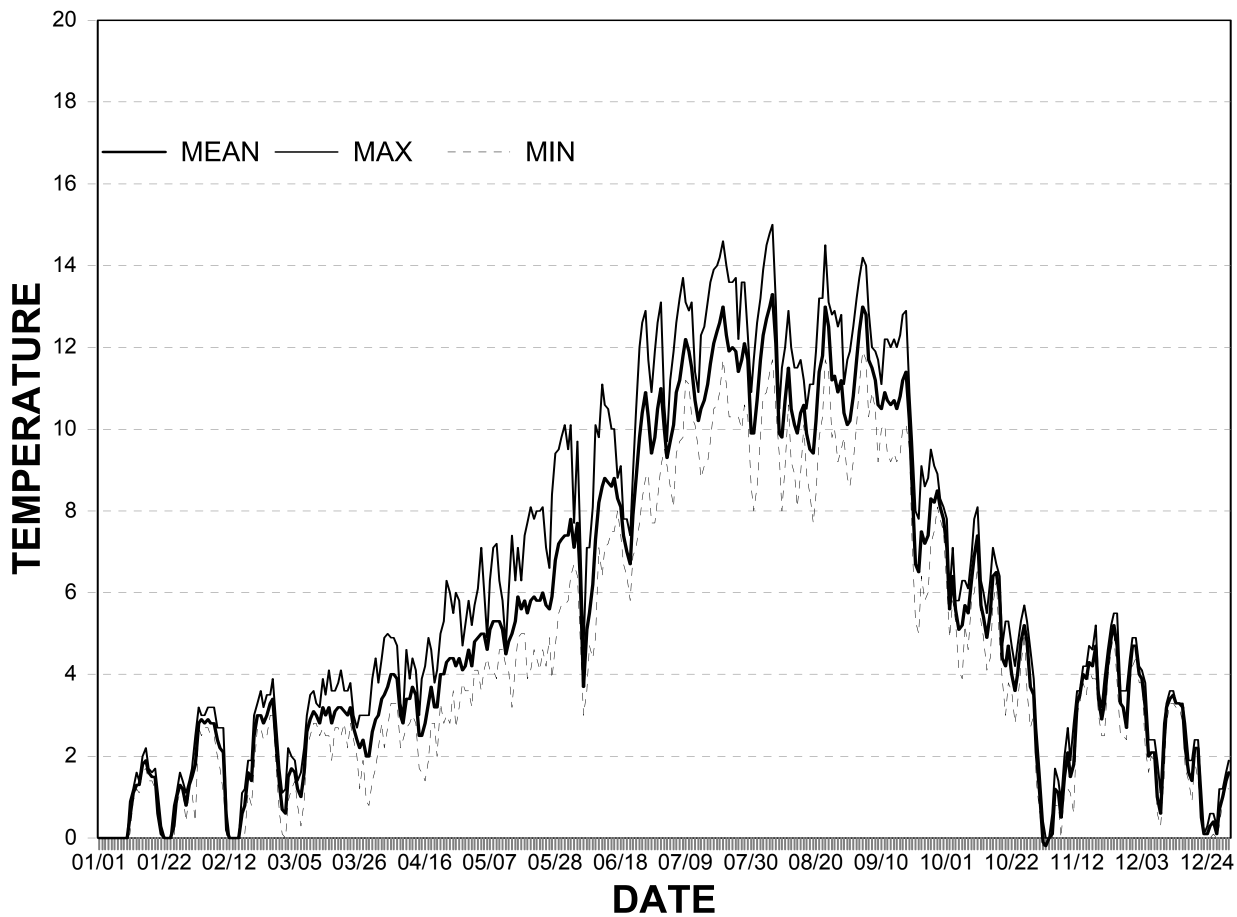
Appendix 6. The daily mean, maximum, and minimum water temperature (°C) in Fish Creek just upstream of Pagoda Creek from January 1, 1995 to December 31, 1995.



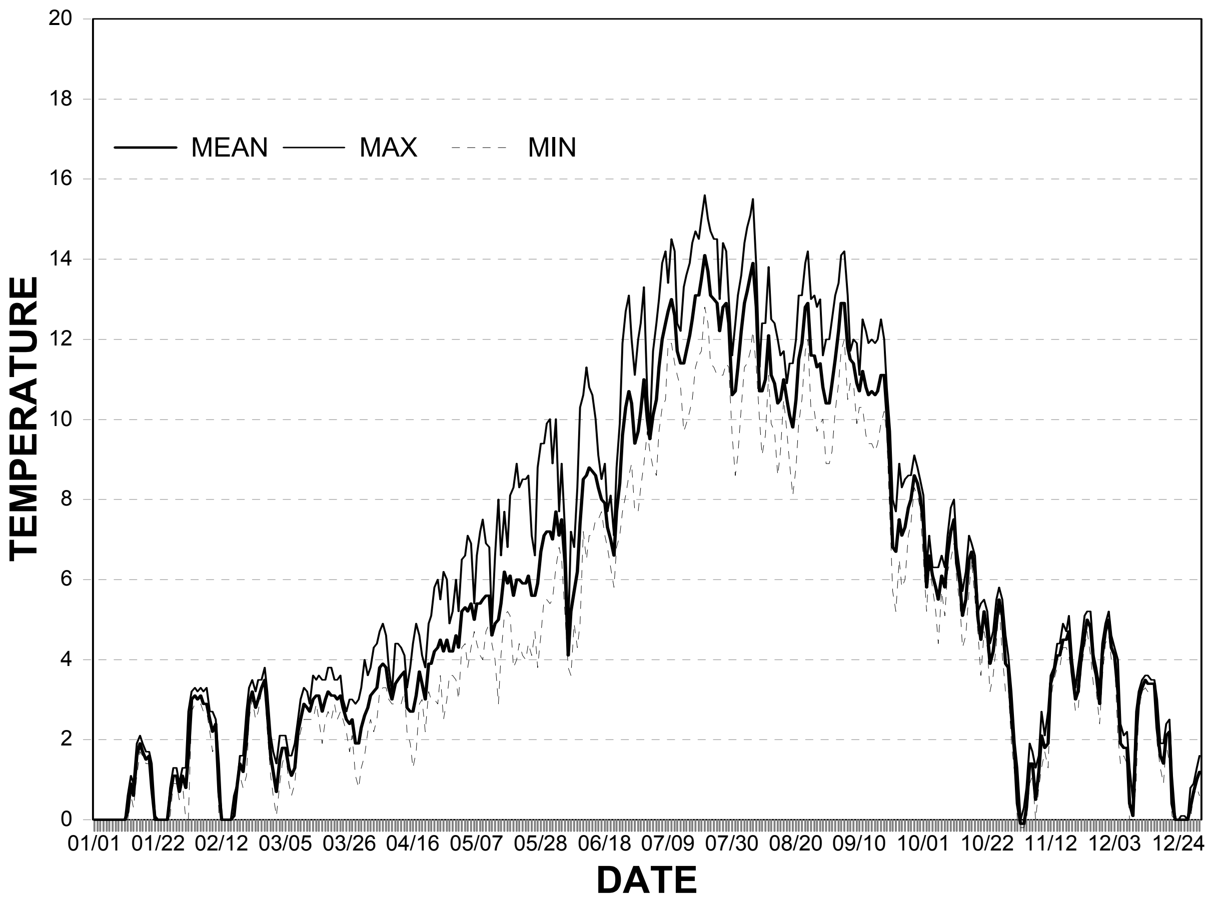
Appendix 7. The daily mean, maximum, and minimum water temperature (°C) in Gedney Creek from January 1, 1995 to December 31, 1995.



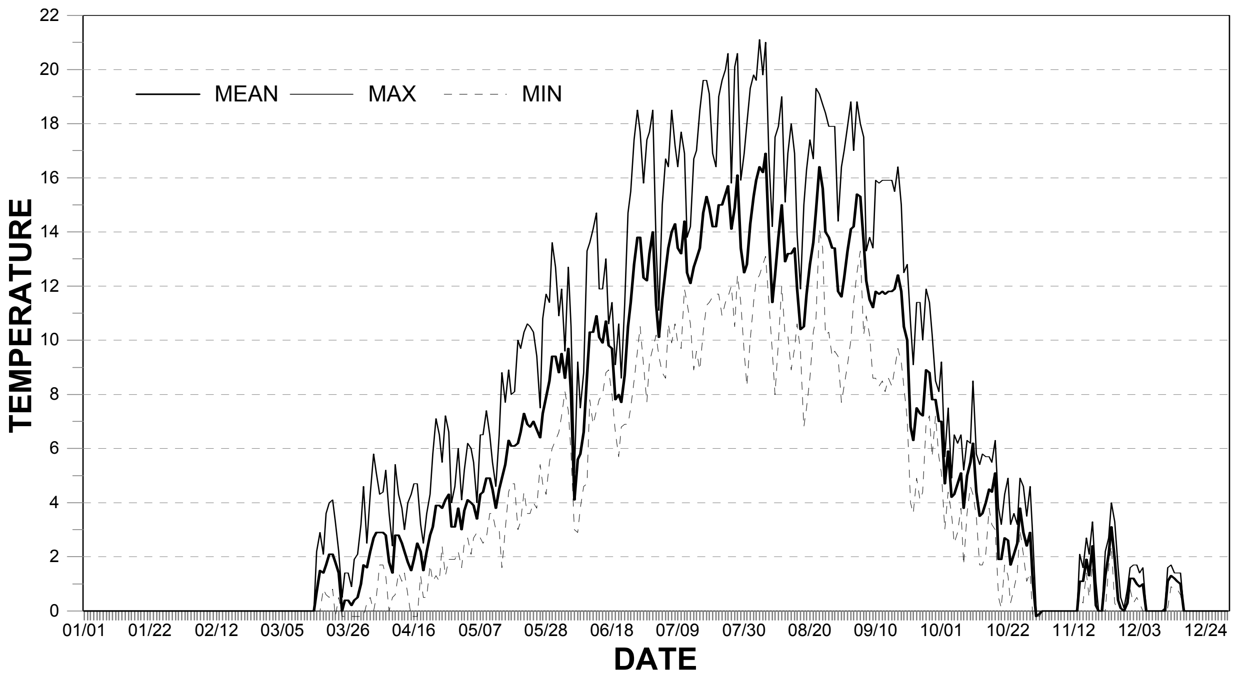
Appendix 8. The daily mean, maximum, and minimum water temperature (°C) in Lost Creek from January 1, 1995 to December 31, 1995.



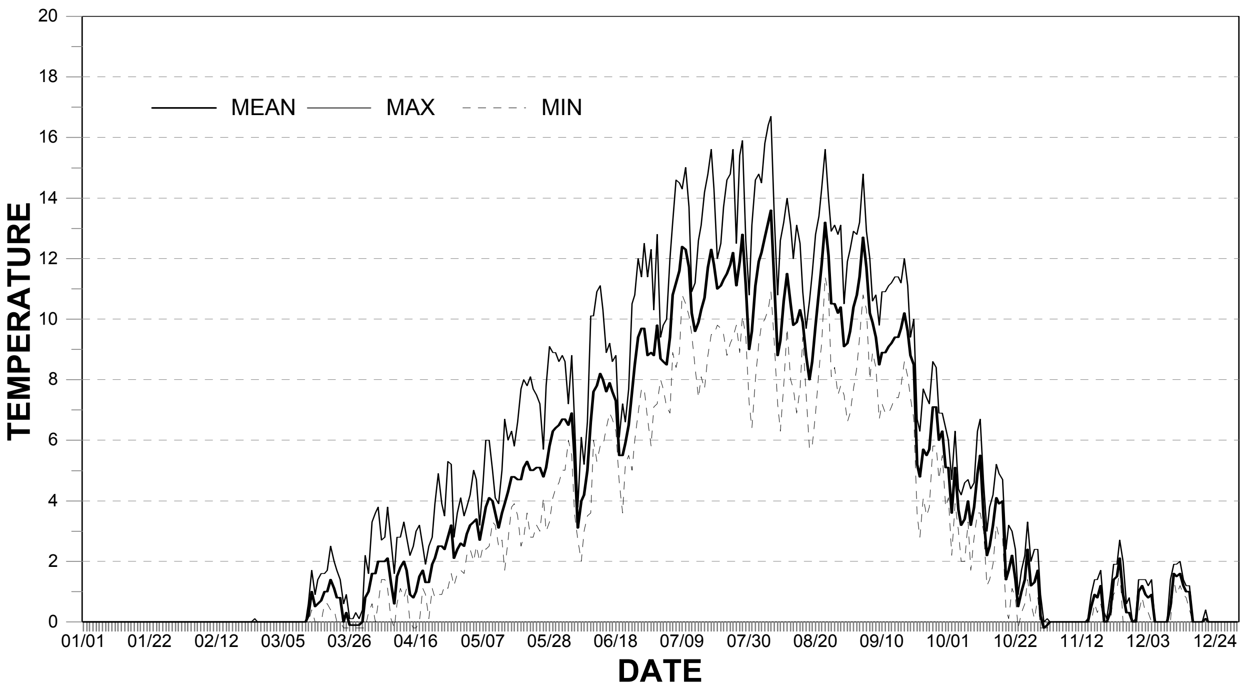
Appendix 9. The daily mean, maximum, and minimum water temperature (°C) in Post Office Creek from January 1, 1995 to December 31, 1995.



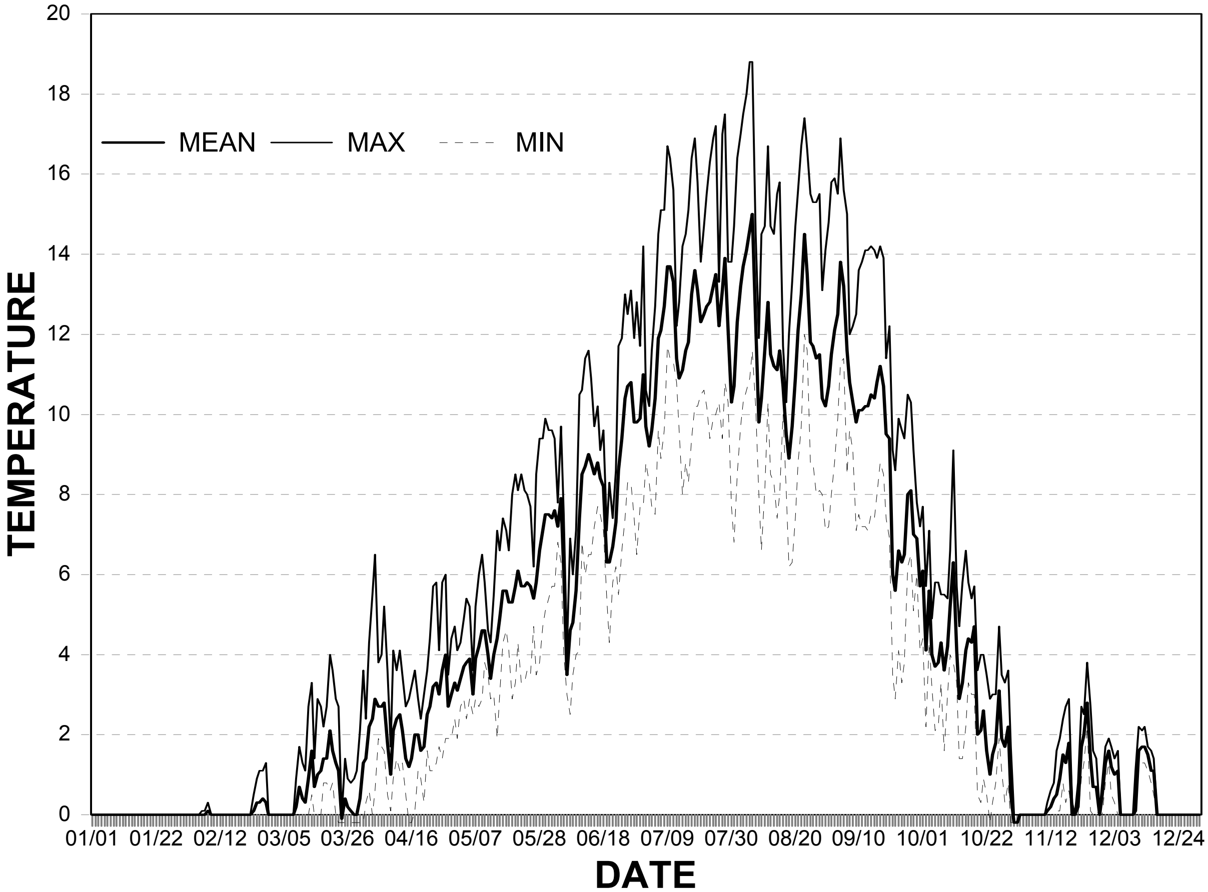
Appendix 10. The daily mean, maximum, and minimum water temperature (°C) in Red River, about 1 km upstream of the South Fork Red River, from January 1, 1995 to December 31, 1995.



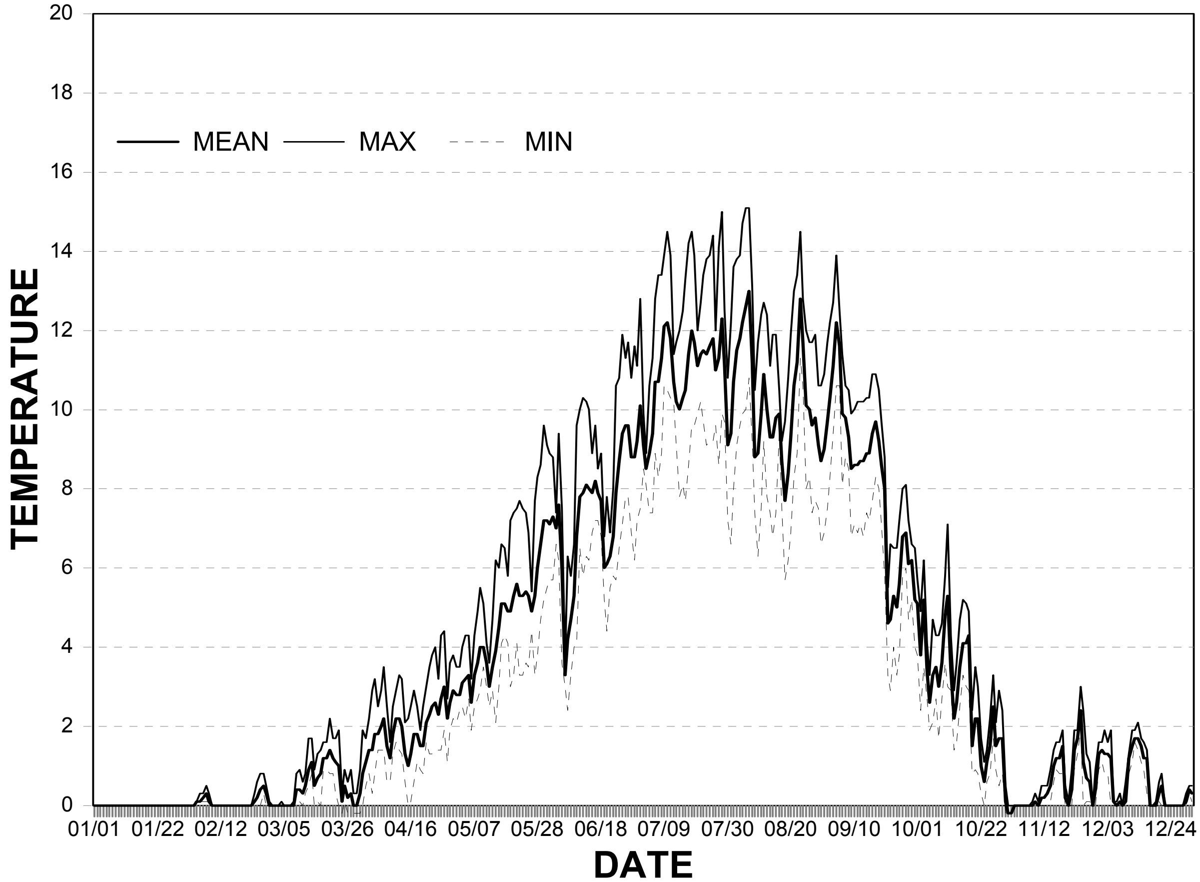
Appendix 11. The daily mean, maximum, and minimum water temperature (°C) in South Fork Red River, about 1 km upstream of Trapper Creek, from January 1, 1995 to December 31, 1995.



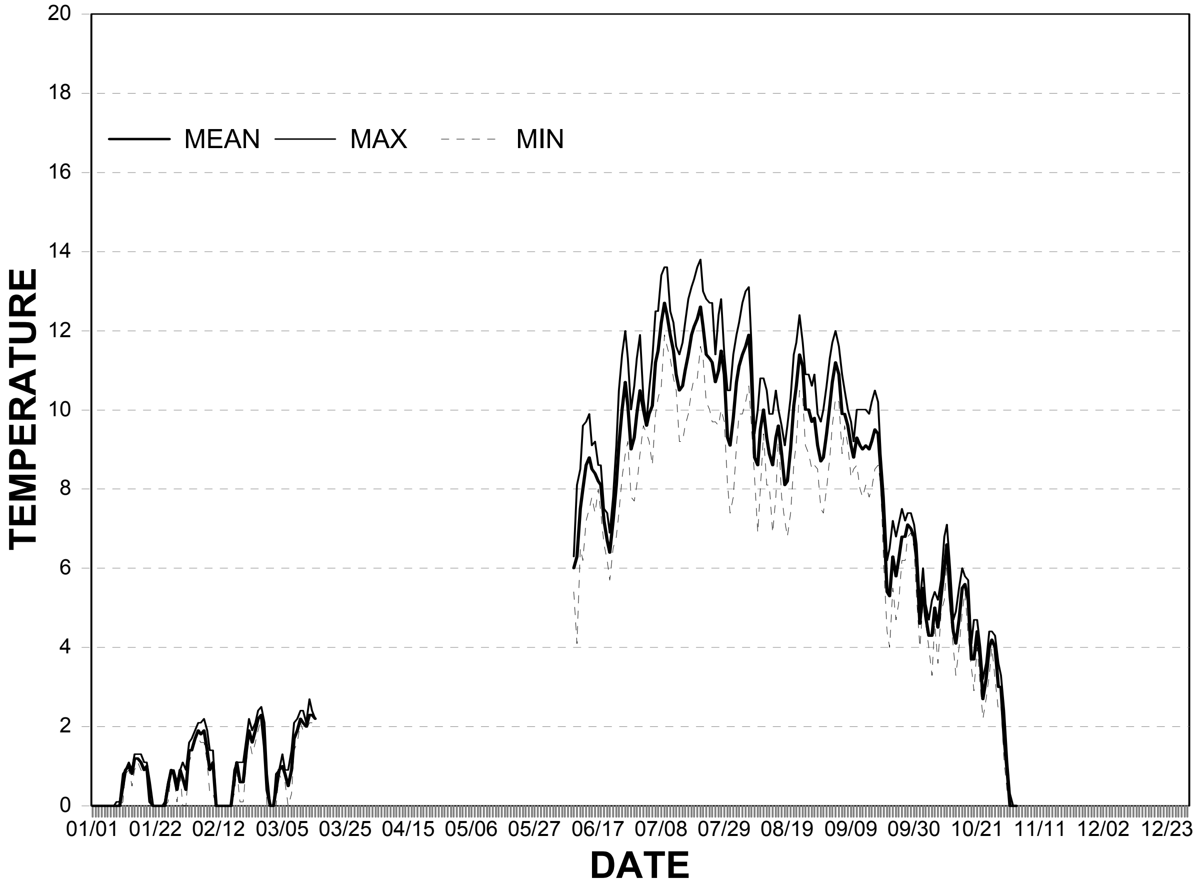
Appendix 12. The daily mean, maximum, and minimum water temperature (°C) in South Fork Red River, at Schooner Creek, from January 1, 1995 to December 31, 1995.



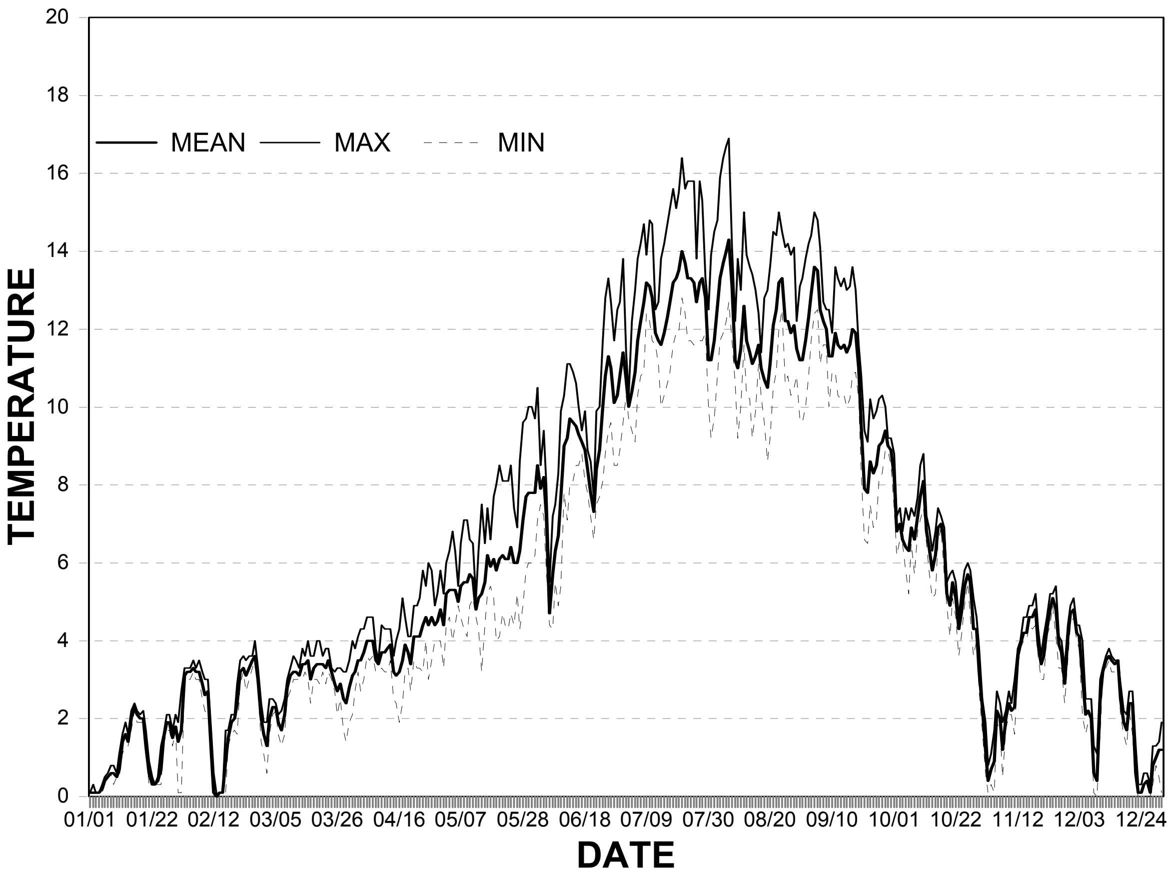
Appendix 13. The daily mean, maximum, and minimum water temperature (°C) in Trapper Creek from January 1, 1995 to December 31, 1995.



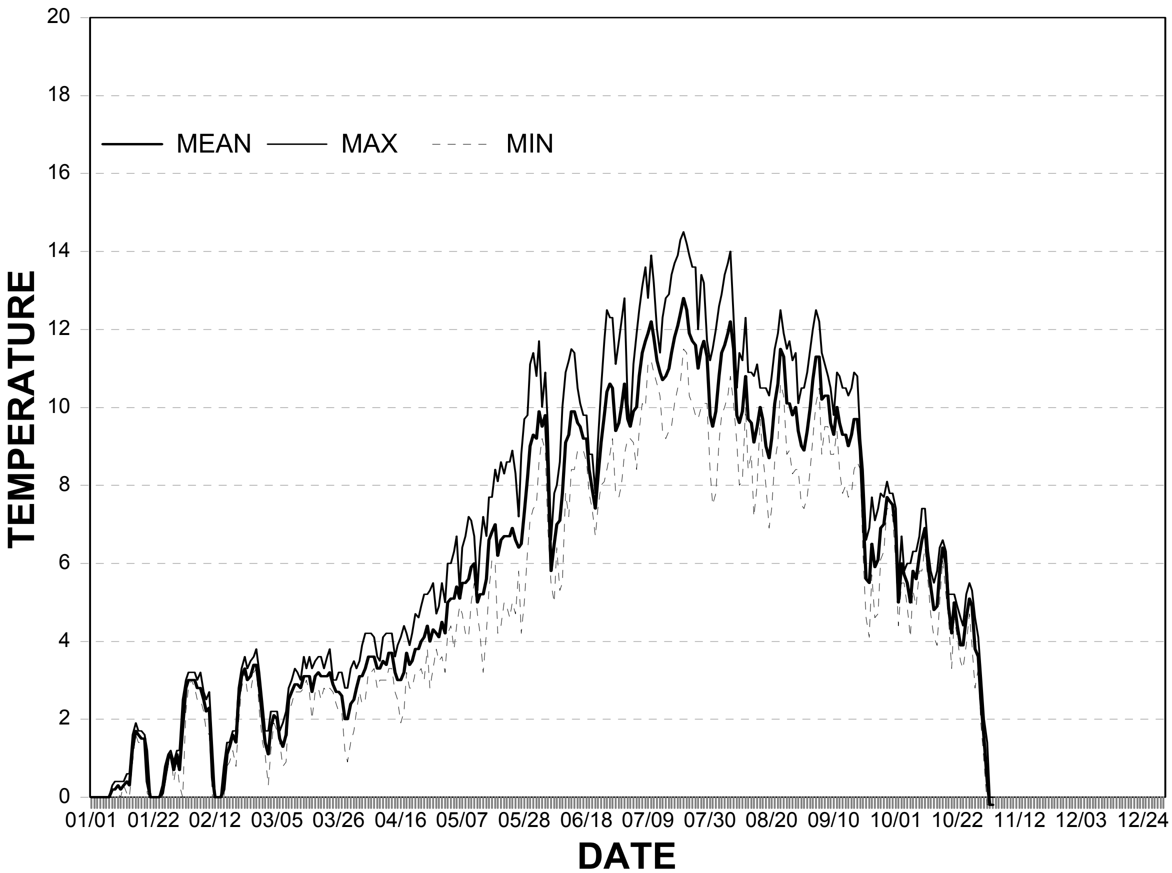
Appendix 14. The daily mean, maximum, and minimum water temperature (°C) in Walton Creek from January 1, 1995 to March 15, 1995 and from June 8, 1995 to December 31, 1995.



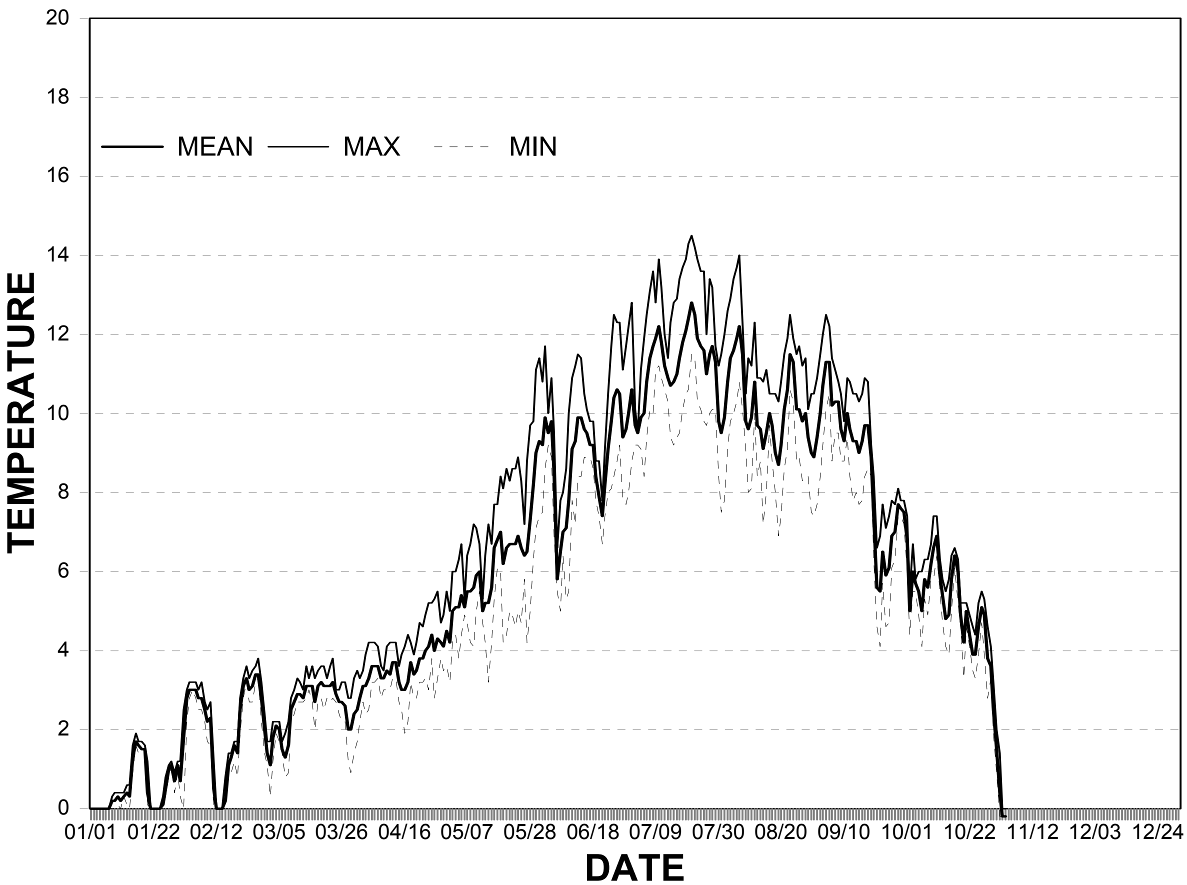
Appendix 15. The daily mean, maximum, and minimum water temperature (°C) in Weir Creek from January 1, 1995 to December 31, 1995.



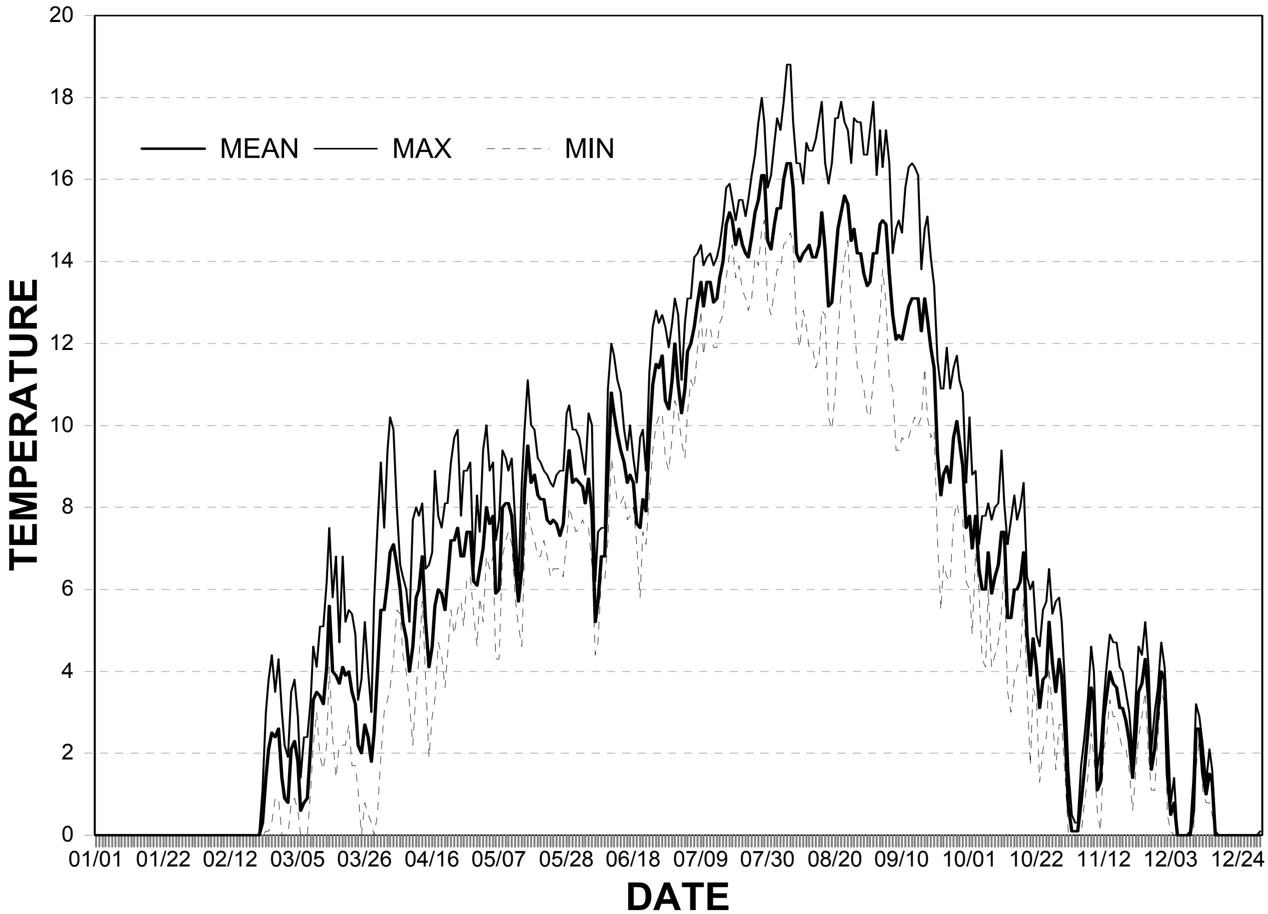
Appendix 16. The daily mean, maximum, and minimum water temperature (°C) in Wendover Creek from January 1, 1995 to December 31, 1995.



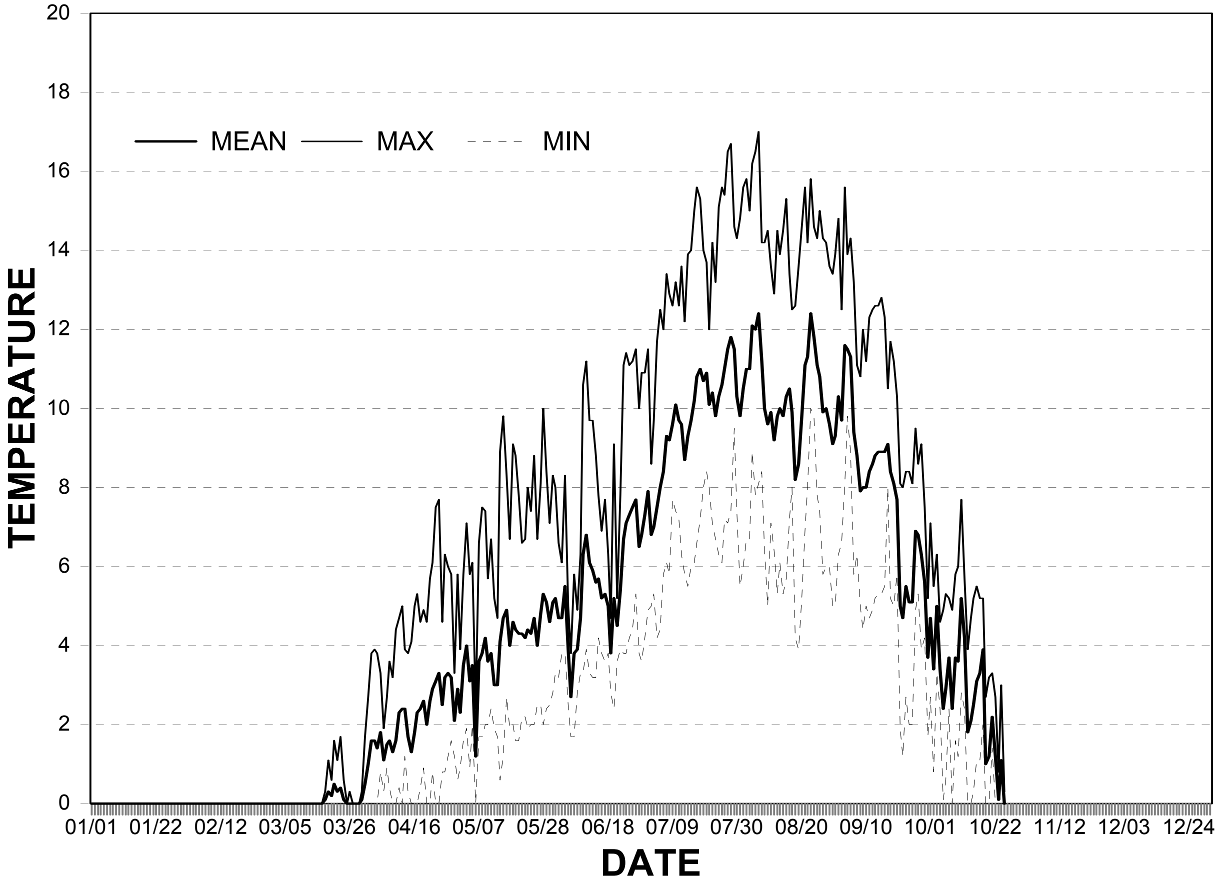
Appendix 17. The daily mean, maximum, and minimum water temperature (°C) in West Fork Gedney Creek from January 1, 1995 to December 31, 1995.



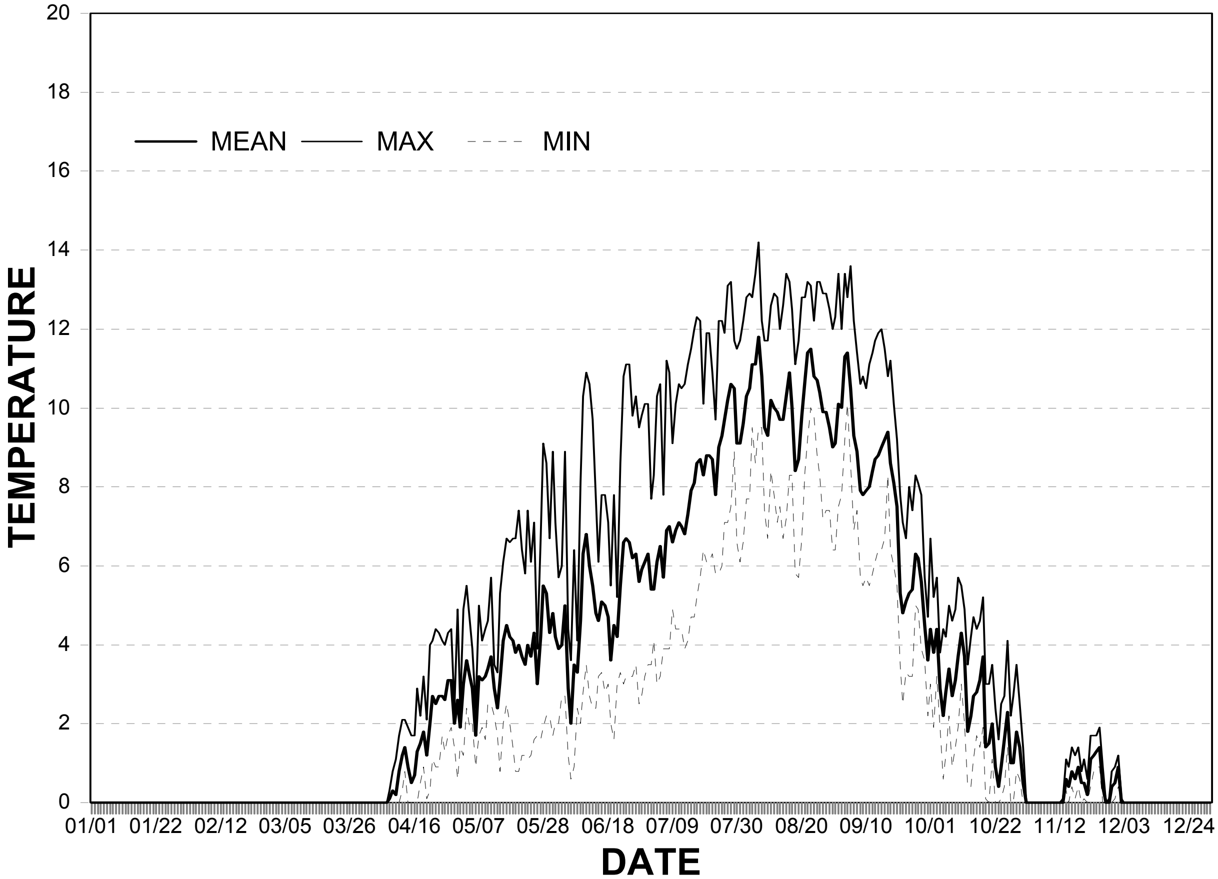
Appendix 18. The daily mean, maximum, and minimum water temperature (°C) in Salmon River, 200 meters upstream of the East Fork Salmon River, from January 1, 1995 to December 31, 1995.



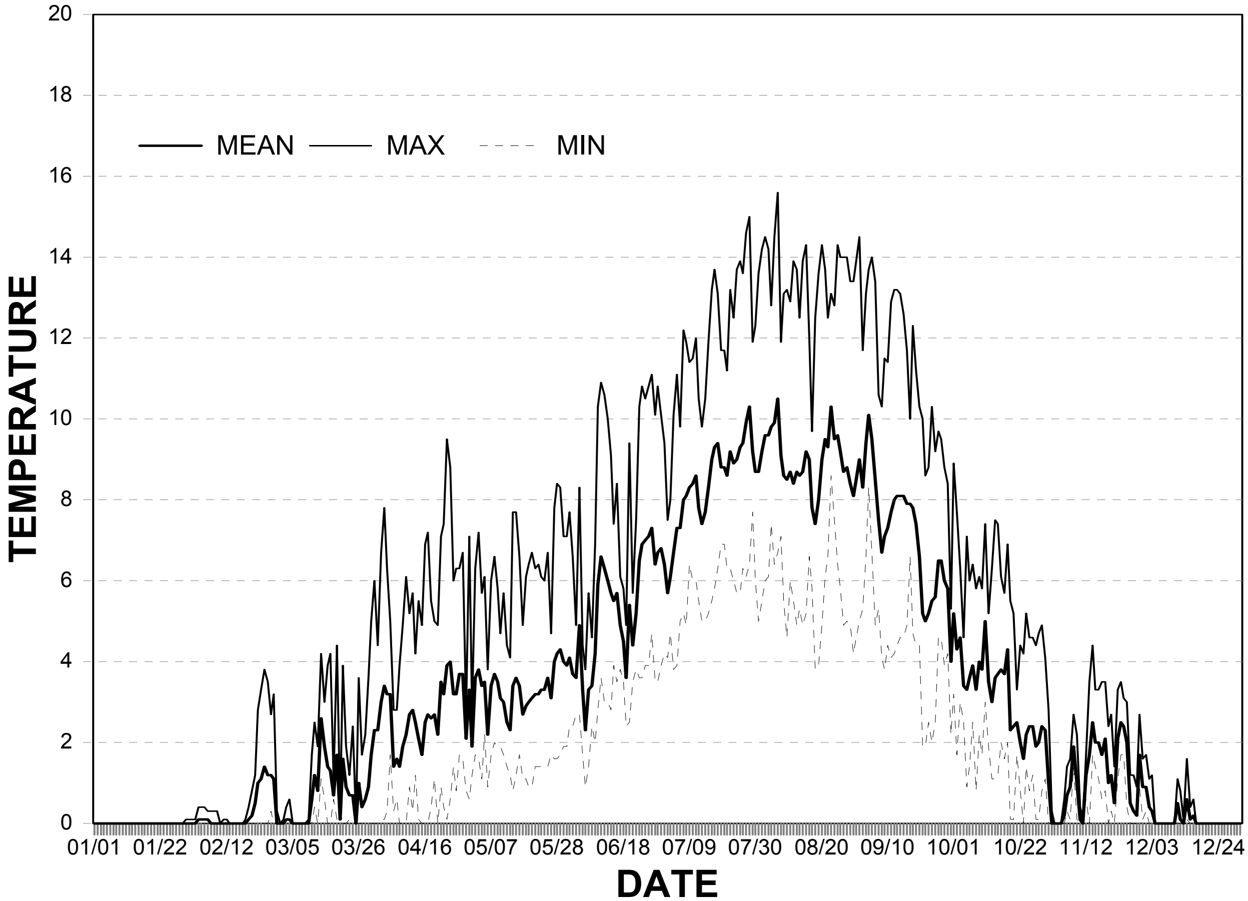
Appendix 19. The daily mean, maximum, and minimum water temperature (°C) in Basin Creek from January 1, 1995 to October 26, 1995.



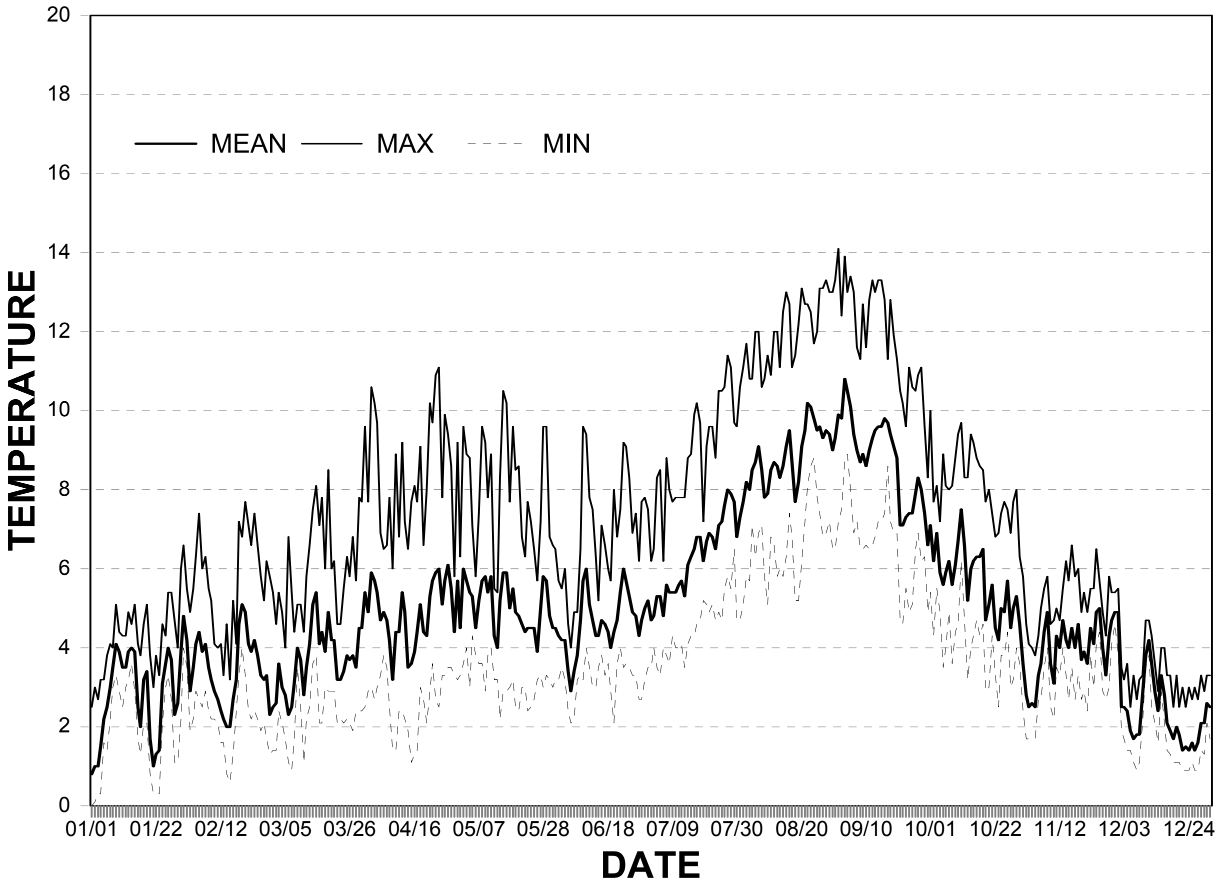
Appendix 20. The daily mean, maximum, and minimum water temperature (°C) in Beaver Creek from January 1, 1995 to December 31, 1995.



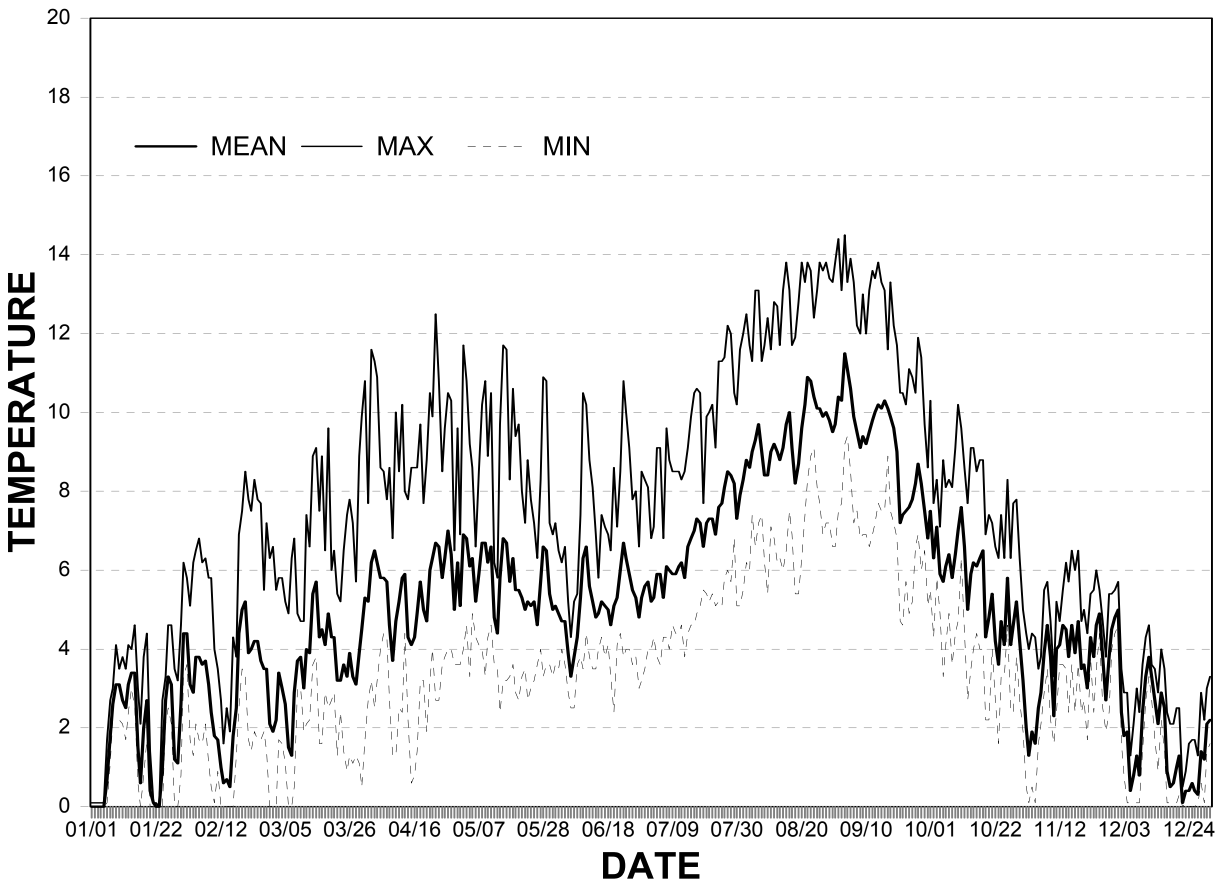
Appendix 21. The daily mean, maximum, and minimum water temperature (°C) in Capehorn Creek from January 1, 1995 to December 31, 1995.



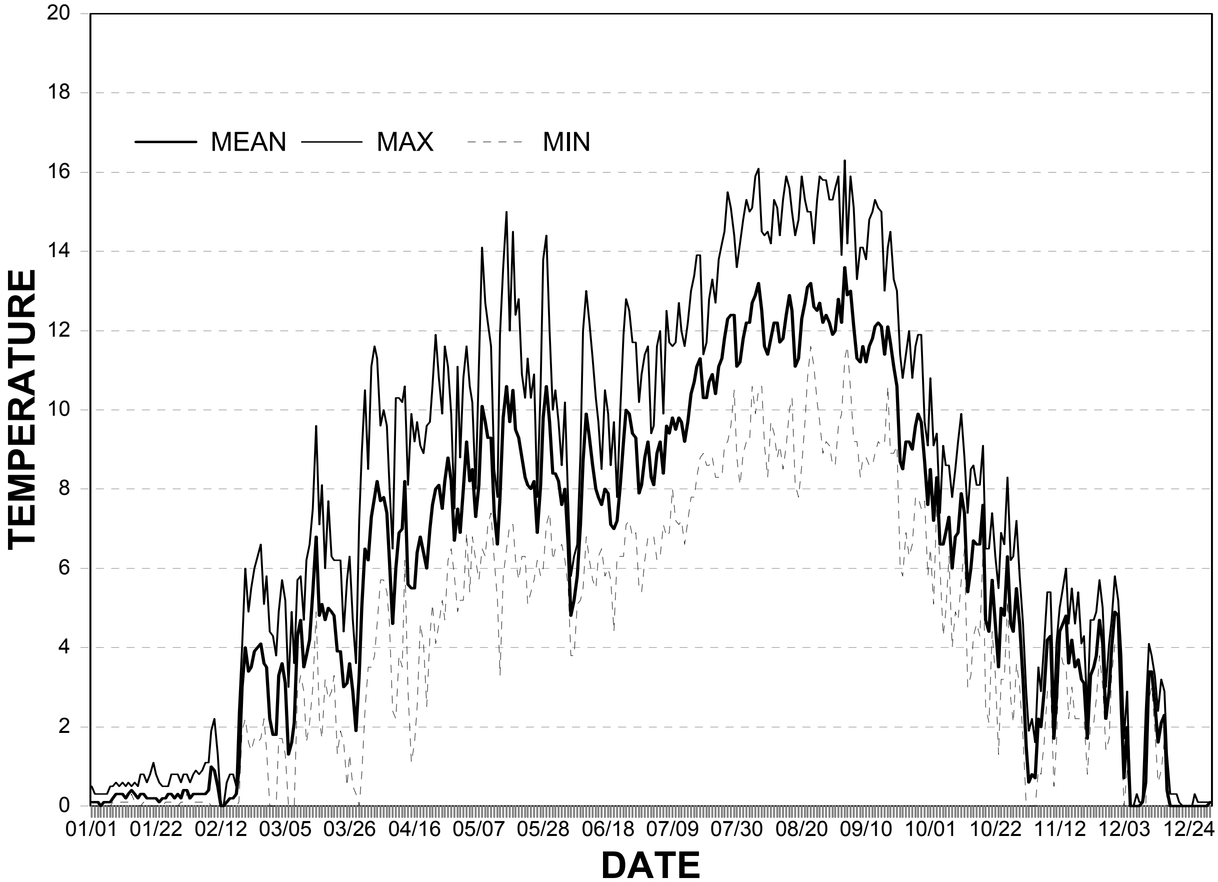
Appendix 22. The daily mean, maximum, and minimum water temperature (°C) in East Fork Salmon River, upstream of Bowery Hot Springs, from January 1, 1995 to December 31, 1995.



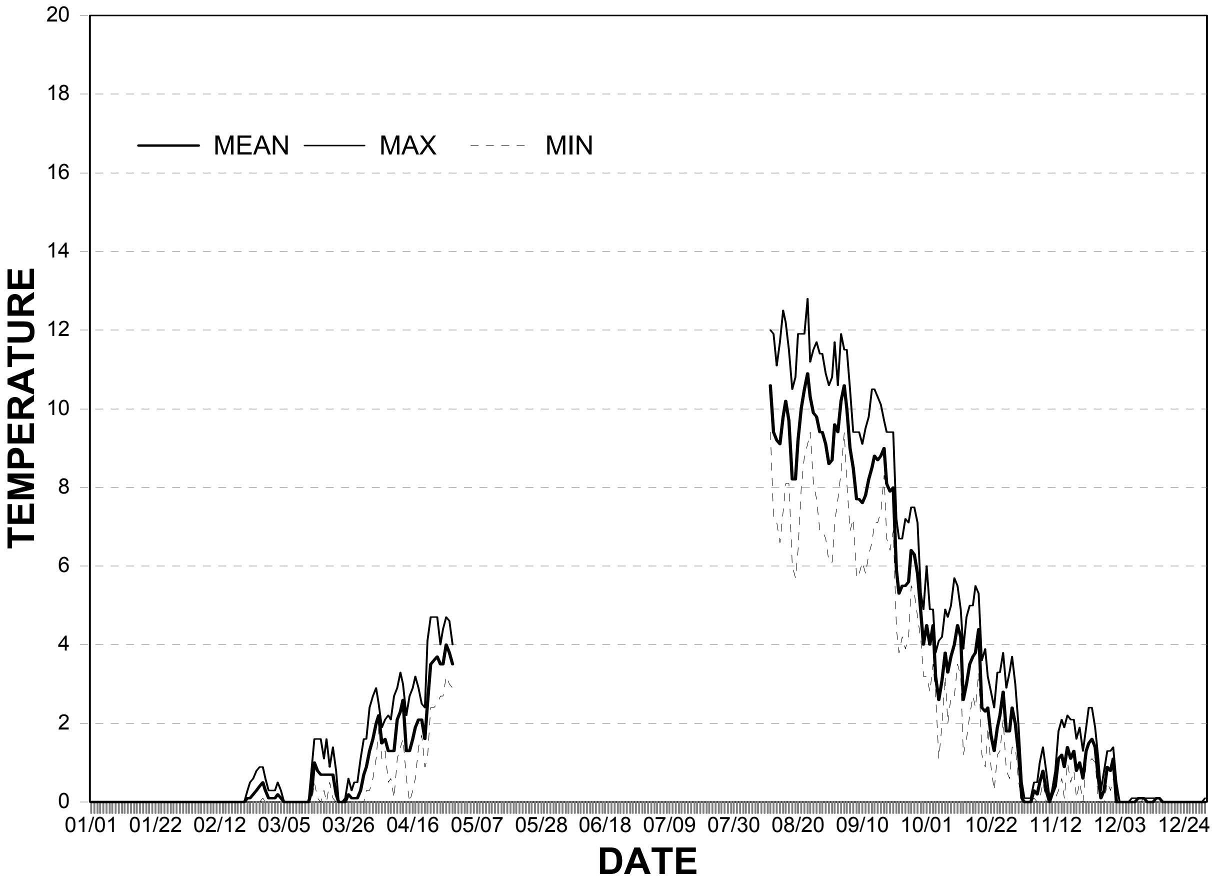
Appendix 23. The daily mean, maximum, and minimum water temperature (°C) in East Fork Salmon River, at Fisher Creek, from January 1, 1995 to December 31, 1995.



Appendix 24. The daily mean, maximum, and minimum water temperature (°C) in East Fork Salmon River, at the mouth, from January 1, 1995 to December 31, 1995.



Appendix 25. The daily mean, maximum, and minimum water temperature (°C) in Frenchman Creek from January 1, 1995 to April 29, 1995 and from August 11, 1995 to December 31, 1995.



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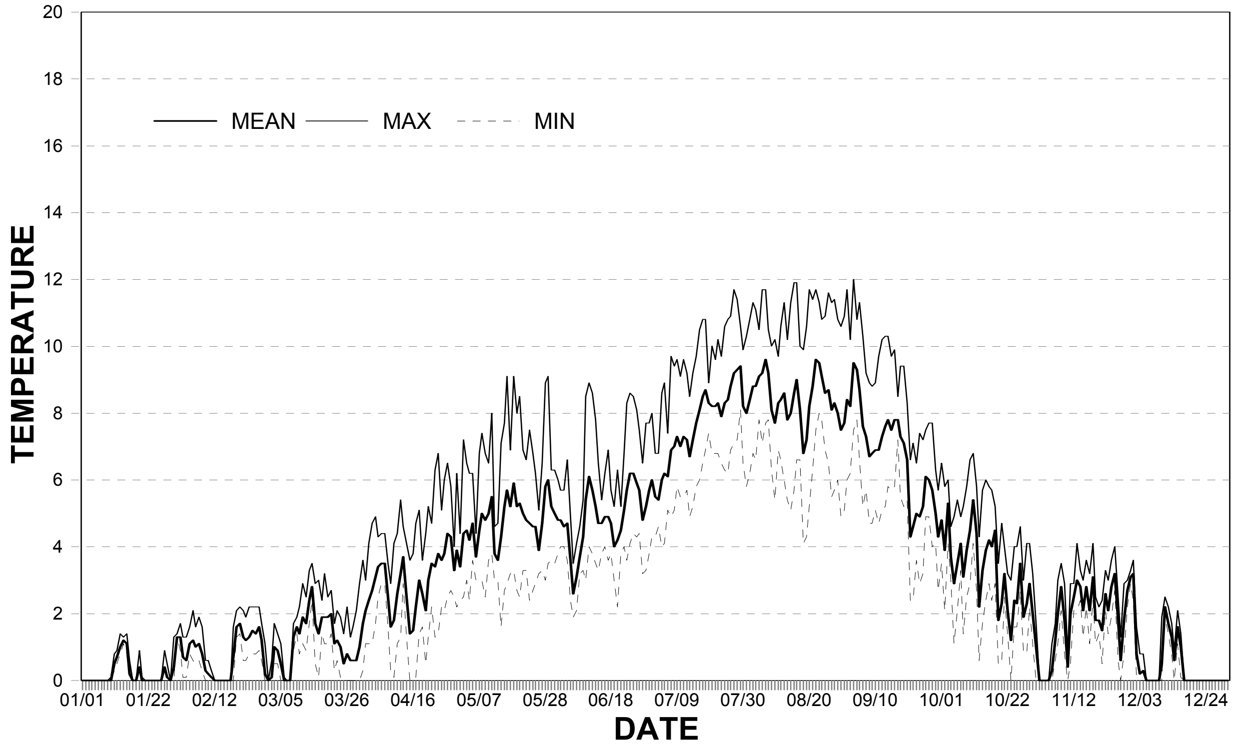
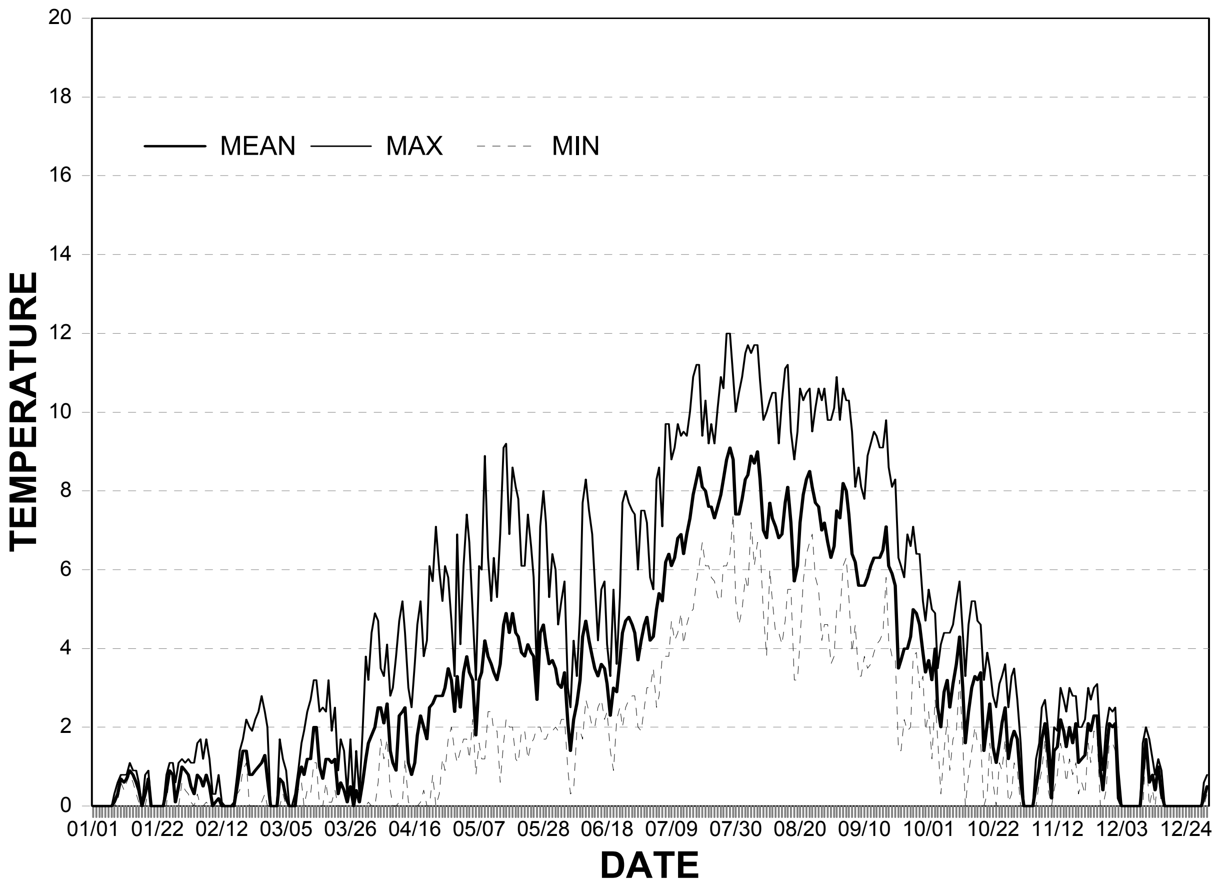
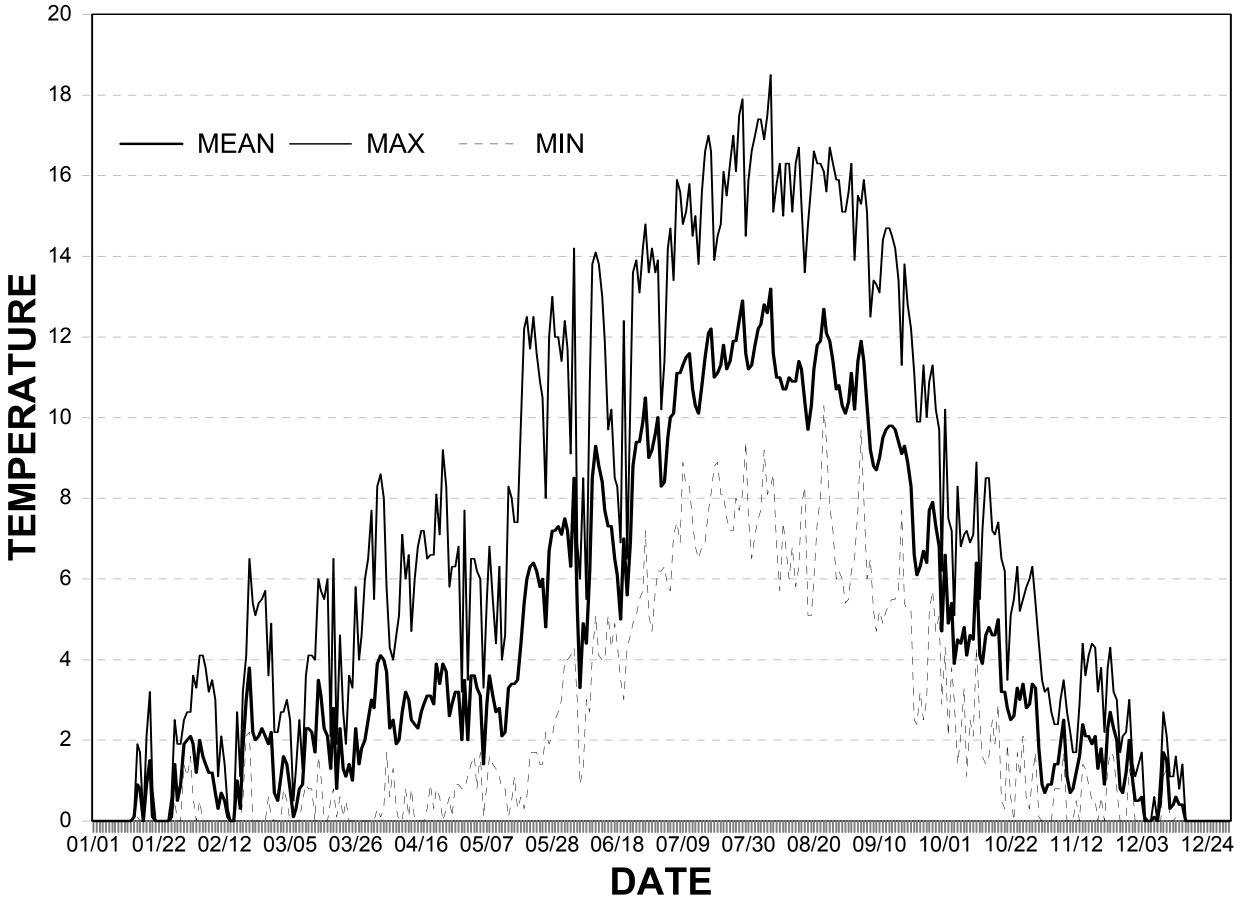
Appendix 26. The daily mean, maximum, and minimum water temperature (°C) in Germania Creek from January 1, 1995 to December 31, 1995.



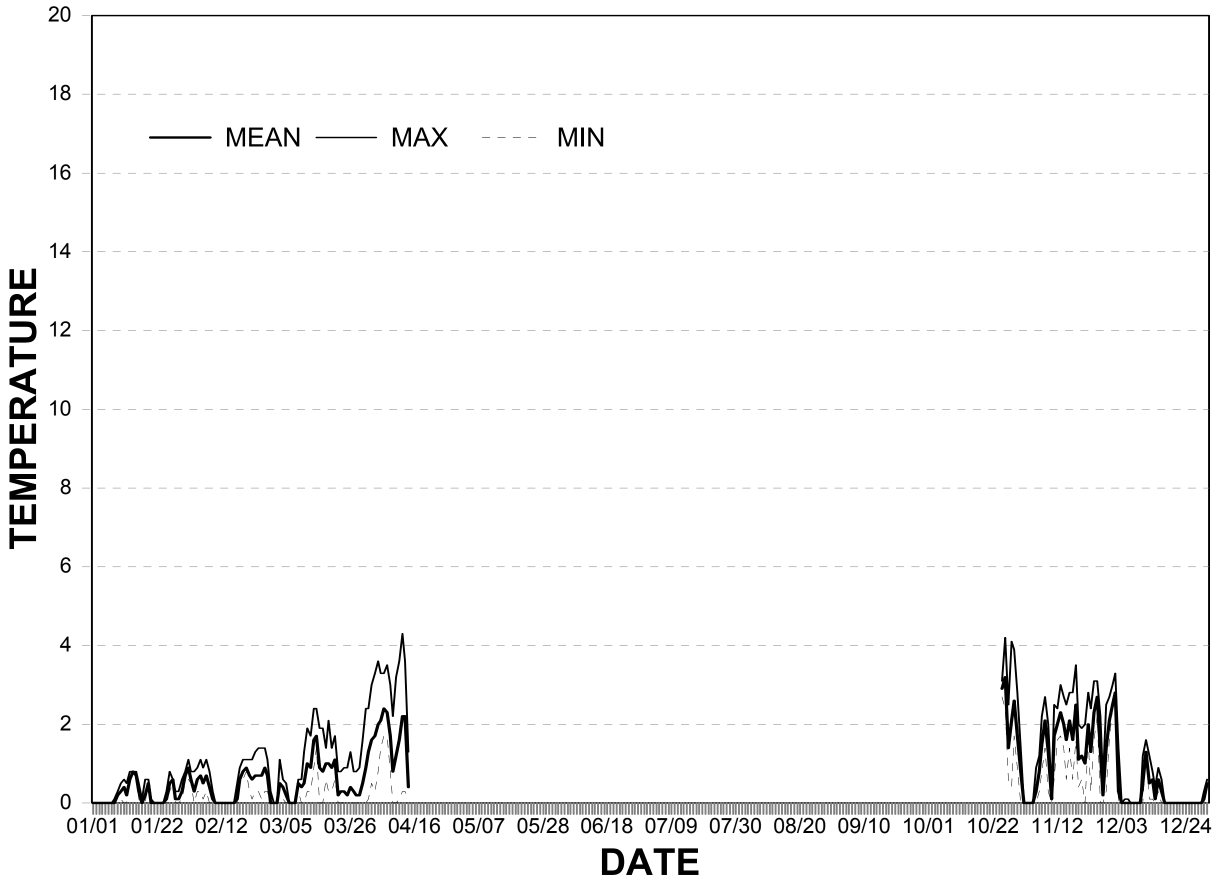
Appendix 27. The daily mean, maximum, and minimum water temperature (°C) in Fourth of July Creek from January 1, 1995 to December 31, 1995.



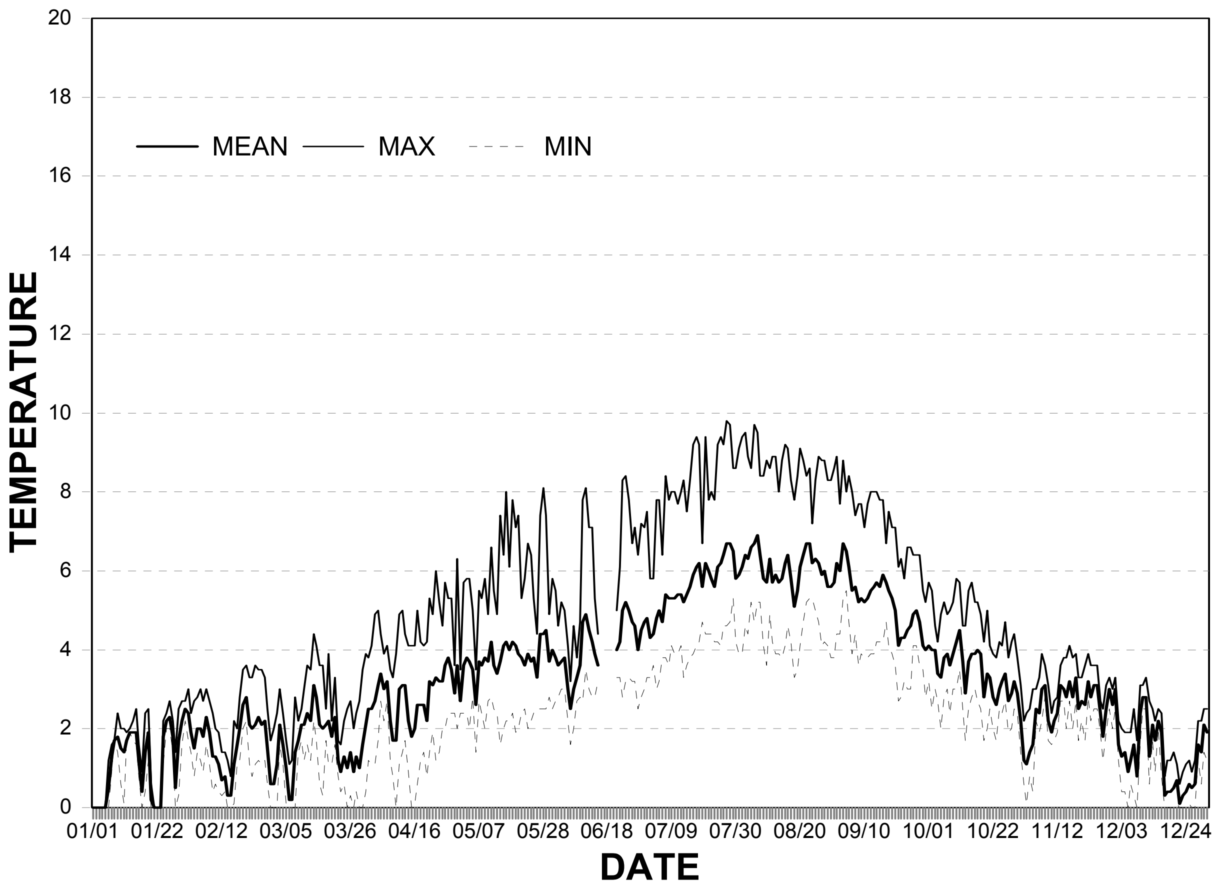
Appendix 28. The daily mean, maximum, and minimum water temperature (°C) in Marsh Creek from January 1, 1995 to December 31, 1995.



Appendix 29. The daily mean, maximum, and minimum water temperature (°C) in West Pass Creek from January 1, 1995 to April 14, 1995 and from October 25, 1995 to December 31, 1995.



Appendix 30. The daily mean, maximum, and minimum water temperature (°C) in Pole Creek from January 1, 1995 to December 31, 1995.



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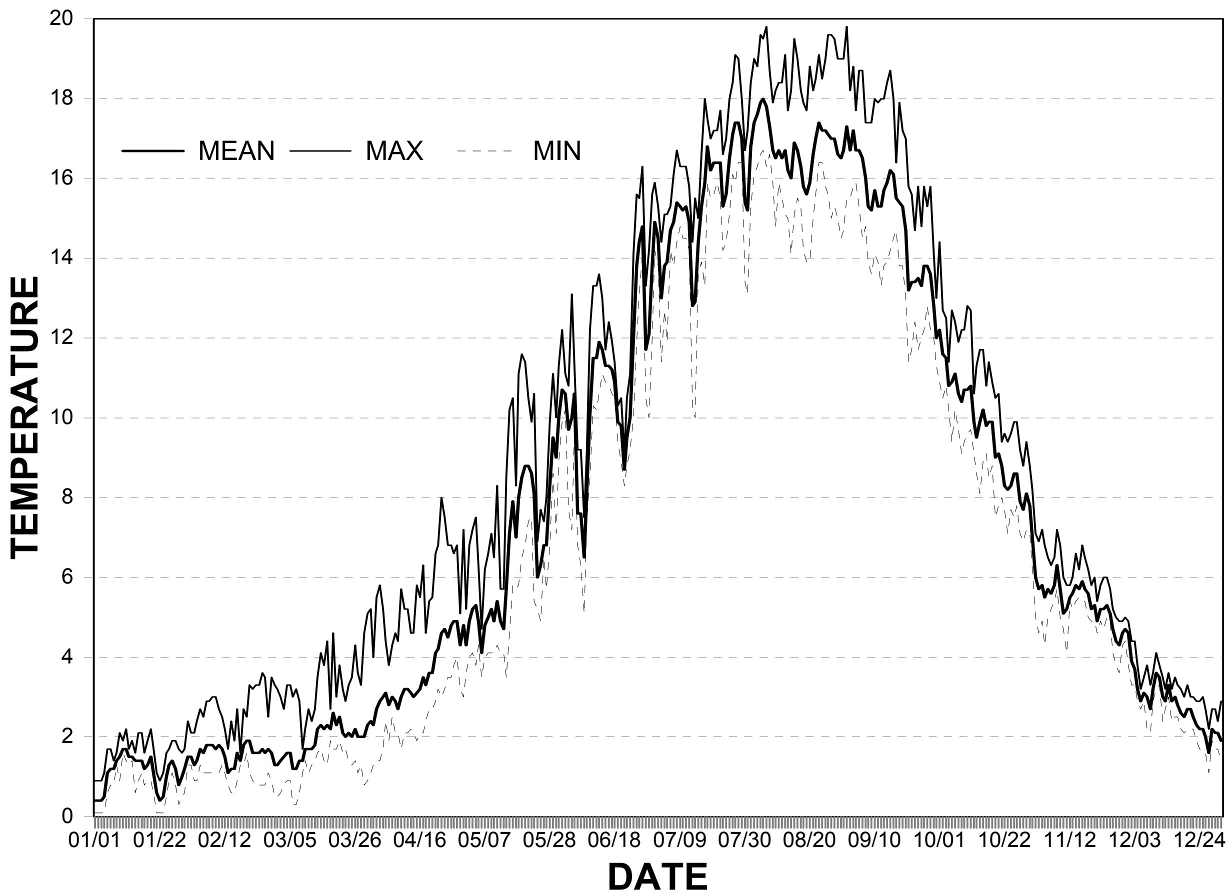
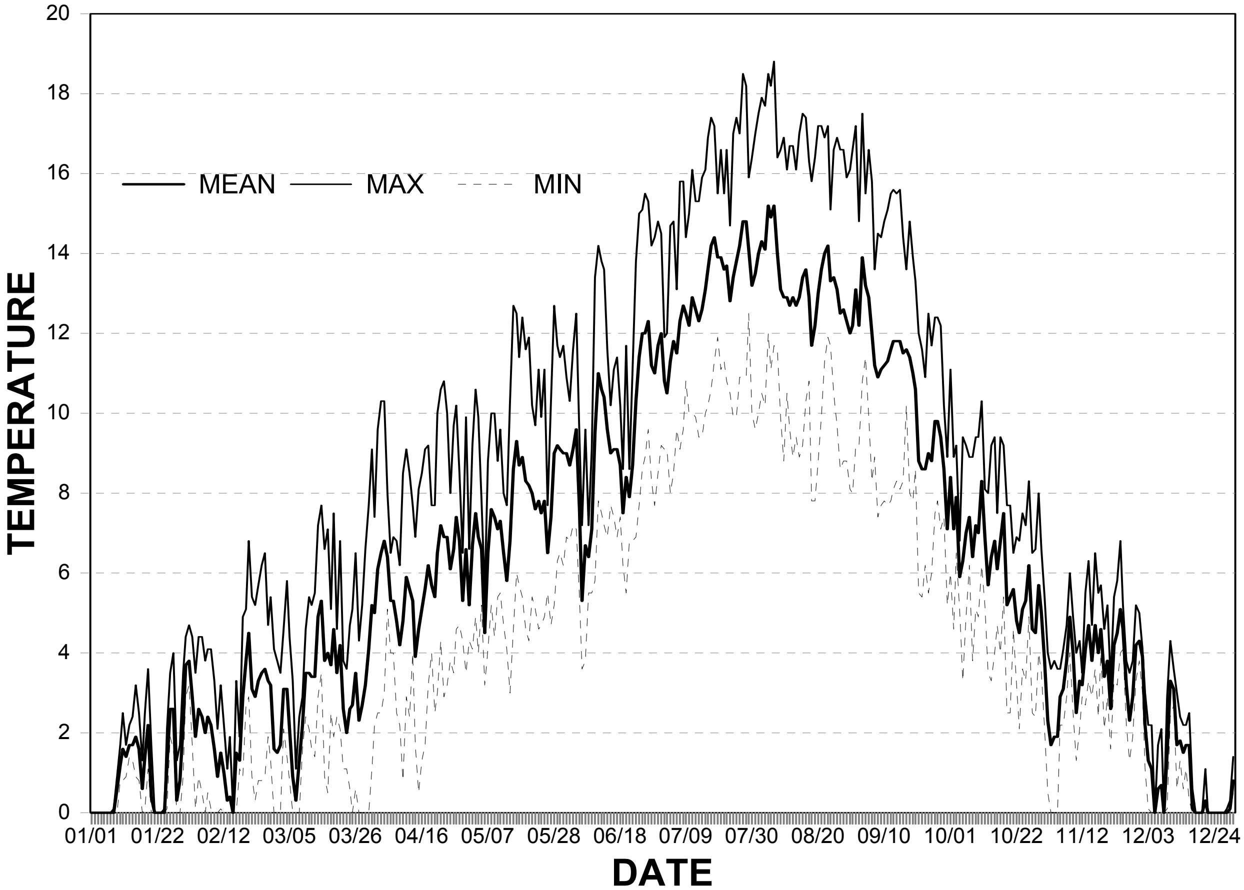
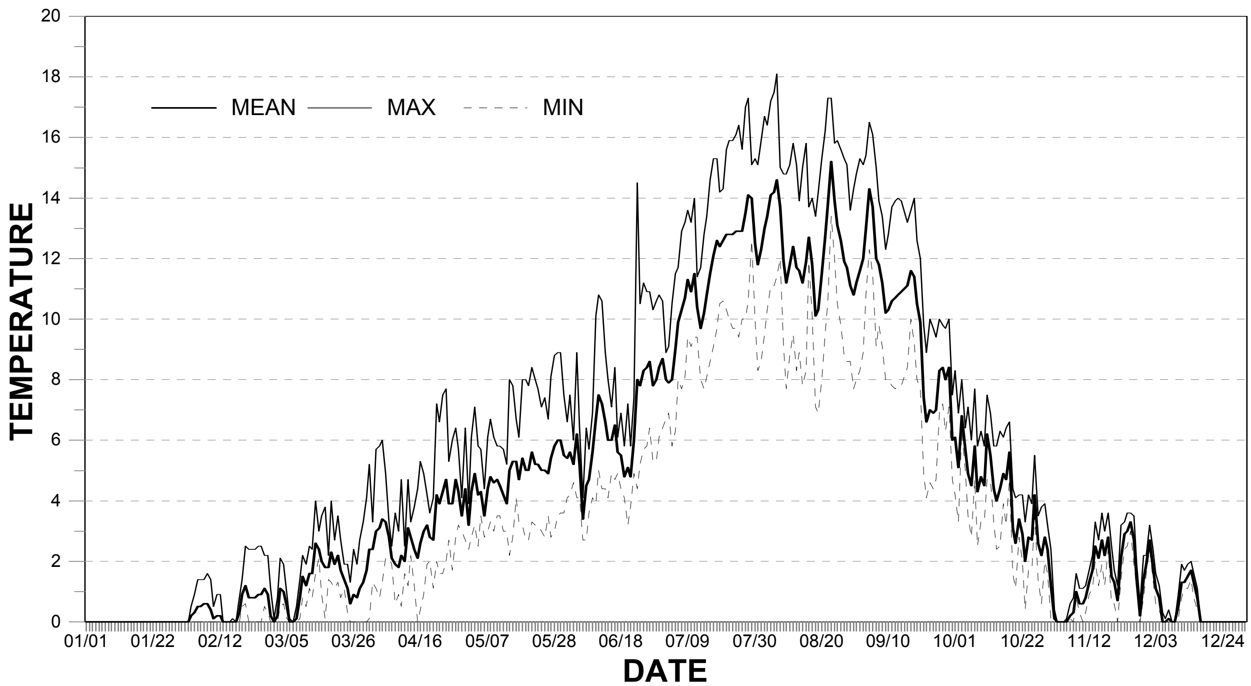
Appendix 31. The daily mean, maximum, and minimum water temperature (°C) in Redfish Lake Creek from January 1, 1995 to December 31, 1995.



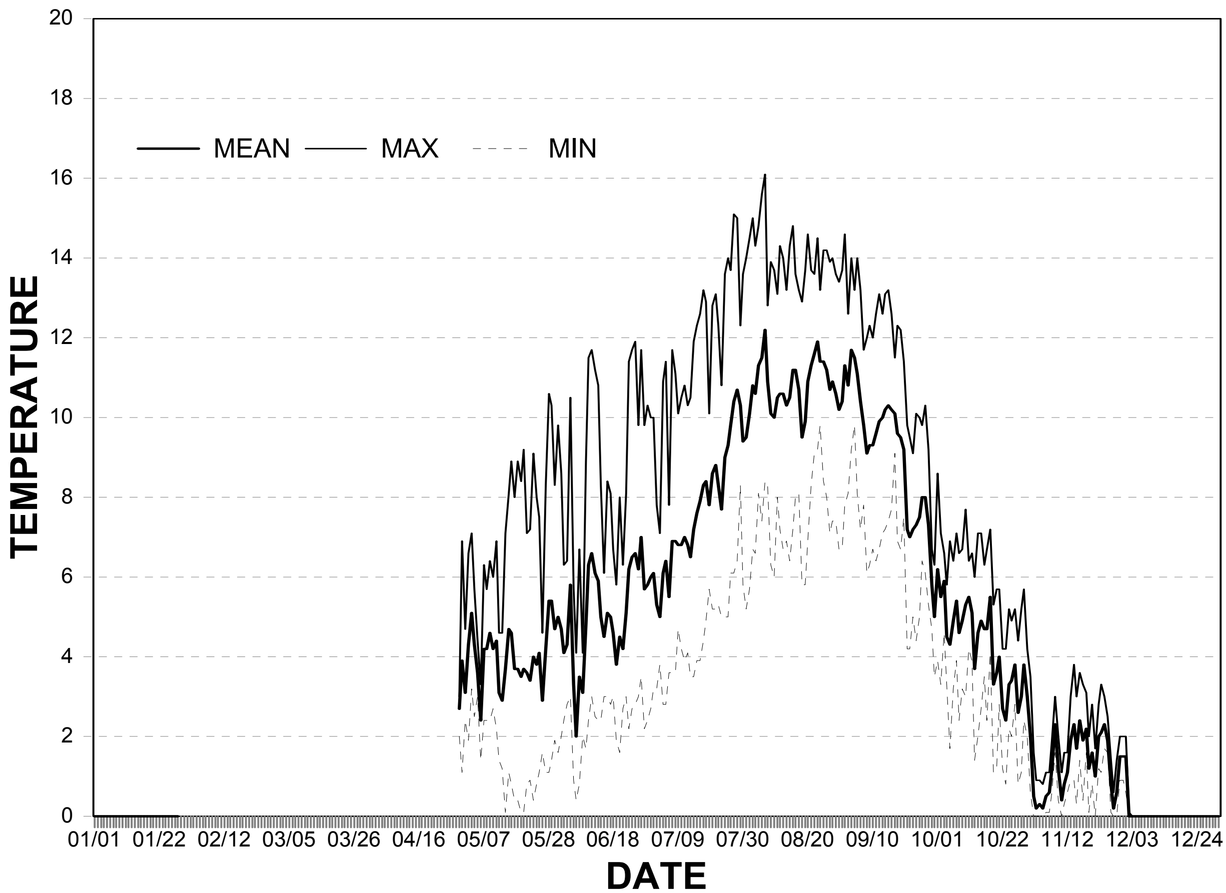
Appendix 32. The daily mean, maximum, and minimum water temperature (°C) in Salmon River, at Sawtooth Fish Hatchery, from January 1, 1995 to December 31, 1995.



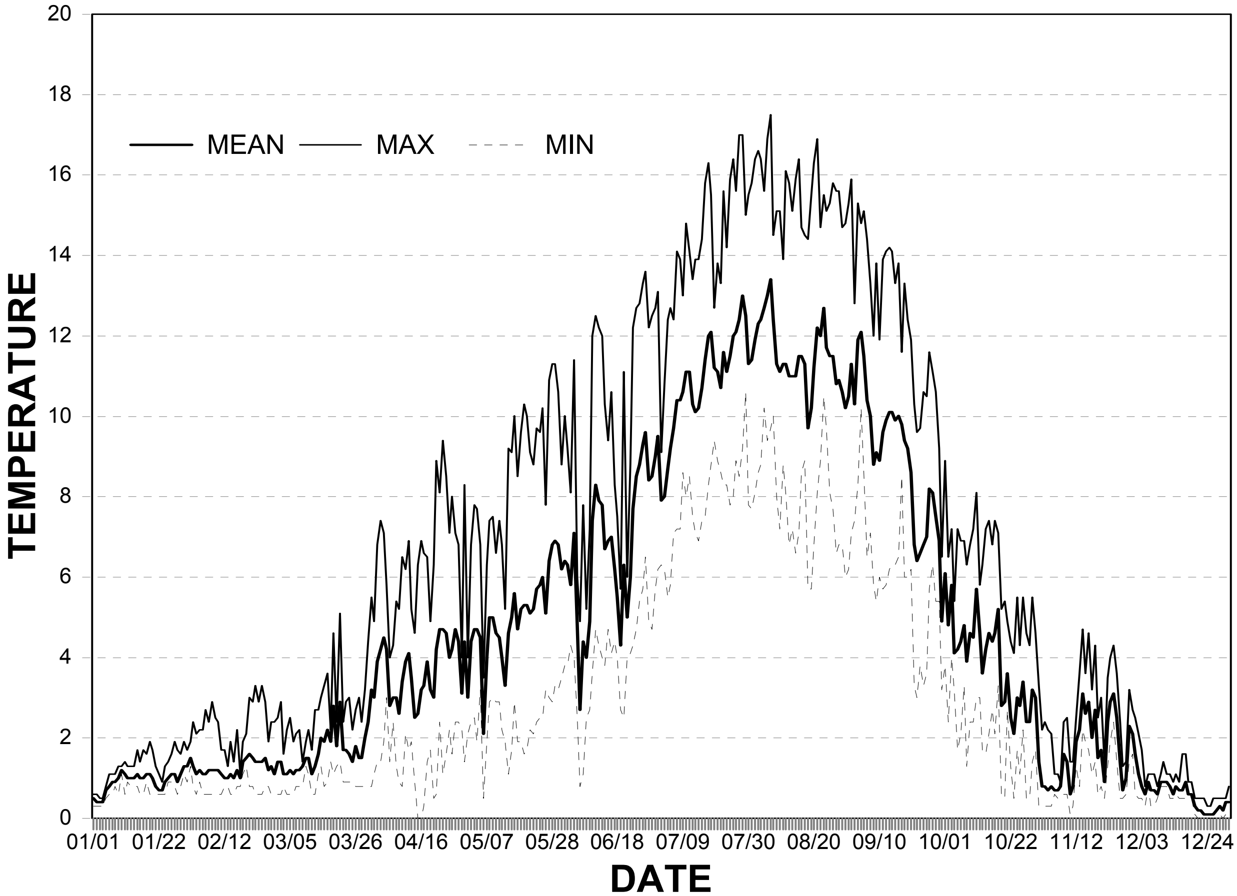
Appendix 33. The daily mean, maximum, and minimum water temperature (°C) in South Fork Salmon River, at the hatchery weir site, from January 1, 1995 to December 31, 1995.



Appendix 34. The daily mean, maximum, and minimum water temperature (°C) in Smiley Creek from April 29, 1995 to December 31, 1995.



Appendix 35. The daily mean, maximum, and minimum water temperature (°C) in Valley Creek from January 1, 1995 to December 31, 1995.



Prepared by:

Alan Byrne
Senior Fishery Research Biologist

Approved by:

IDAHO DEPARTMENT OF FISH AND GAME

Virgil K. Moore, Chief
Bureau of Fisheries

Steve Yundt
Fishery Research Manager